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DEPARTMENT OF COMMERCE AND INDUSTRIES

FISHERIES AND MARINE BIOLOGICAL
SURVEY DIVISION

INVESTIGATIONAL REPORT No. 11

PRELIMINARY INVESTIGATIONS ON THE FOODS OF SOUTH AFRICAN FISHES

(With Notes on the General Fauna of the Area Surveyed)

BY

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Introduction.

As far as is known, no work on the organisms comprising the food of the commercial fishes of South African waters has been done, except by J. M. Rattray (1947).

When the present investigation was started in March, 1946, it was decided that the fishes to be dealt with should be the Cape Stockfish (*Merluccius capensis*), this being by far the most important fish commercially, and a number of the inshore fishes from False Bay such as the Silverfish (*Polysteganus argyrozona*), the Panga (*Pterogymnus laniarius*), the White Stumpnose (*Austrosparus globiceps*), the Red Stumpnose (*Chrysoblephus gibbiceps*) and others.

It is hoped that this will be the beginning of many years' work on the foods and general biology of fishes. In conjunction with this investigation on food organisms, the Zoology Department of the University of Capé Town has started a survey of the bottom fauna of both Table and False Bays with the use of bottom dredge nets from fishing boats. Work on bottom fauna has recently been extended to the trawling areas of the West Coast where samples are being collected by the R.S. " Africana ". Although the fishes dealt with in this paper were obtained mainly from deeper waters away from the bays, it is hoped that it will be possible to include the inshore fish in a later publication.

By the courtesy of Messrs. Irvin and Johnson (South Africa), Ltd., weekly samples of stockfish, together with other fish from the West Ground were obtained. But it was found to be impossible to obtain regular samples of fish from False Bay from the boats at Kalk Bay harbour, as the fish were sold to dealers as soon as the boats arrived and the only means of obtaining fish was by, so to speak, borrowing them from Coloured women who cleaned and gutted odd fish for private buyers. This method was carried out for three months and was found to be most unsatisfactory. Then in May most of the Kalk Bay boats moved round to Hout Bay to fish for snoek only and no supplies of other fish were obtainable.

In June, 1946, Dr. K. H. Barnard of the South African Museum informed me of Rattray's paper on the food of the Cape stockfish (*op. cit.*) and loaned me a copy. At this time I was also shown E. R. Roux's paper " A Preliminary Investigation of the General Biology of the South African Hake or Stockfish (1946) " and it therefore seemed that further work on the investigation of the food of the stockfish would be redundant. Luckily, however, other fish from the West Ground, such as Kingklip (*Genypterus capensis*), Sancords (the so-called Jacopevers) (*Helicolenus maculatus*), John Dories (*Zeus capensis*) and others had been included in the stockfish samples, and length-measurements and weights had been taken and stomach contents examined. So it was decided to continue work on the stockfish in the hope that some new recordings of food organisms would be found, and to concentrate on the other fish from this area.

After a short while, it was realized that to deal with these West Ground fish at all thoroughly, would take a fair amount of time and good deal of labour. So it was decided to leave the False Bay inshore fish for the present and to work on the West Ground fish only.

As has already been mentioned, the investigation is only a beginning of work which will take a number of years before anything like a complete picture of the food cycle in relation to any one species of this area is worked out. But is was hoped that, by going through regular weekly samples of fish over a period of a full year as a minimum period, some indication of the possible seasonal changes in food, the variation of food with the

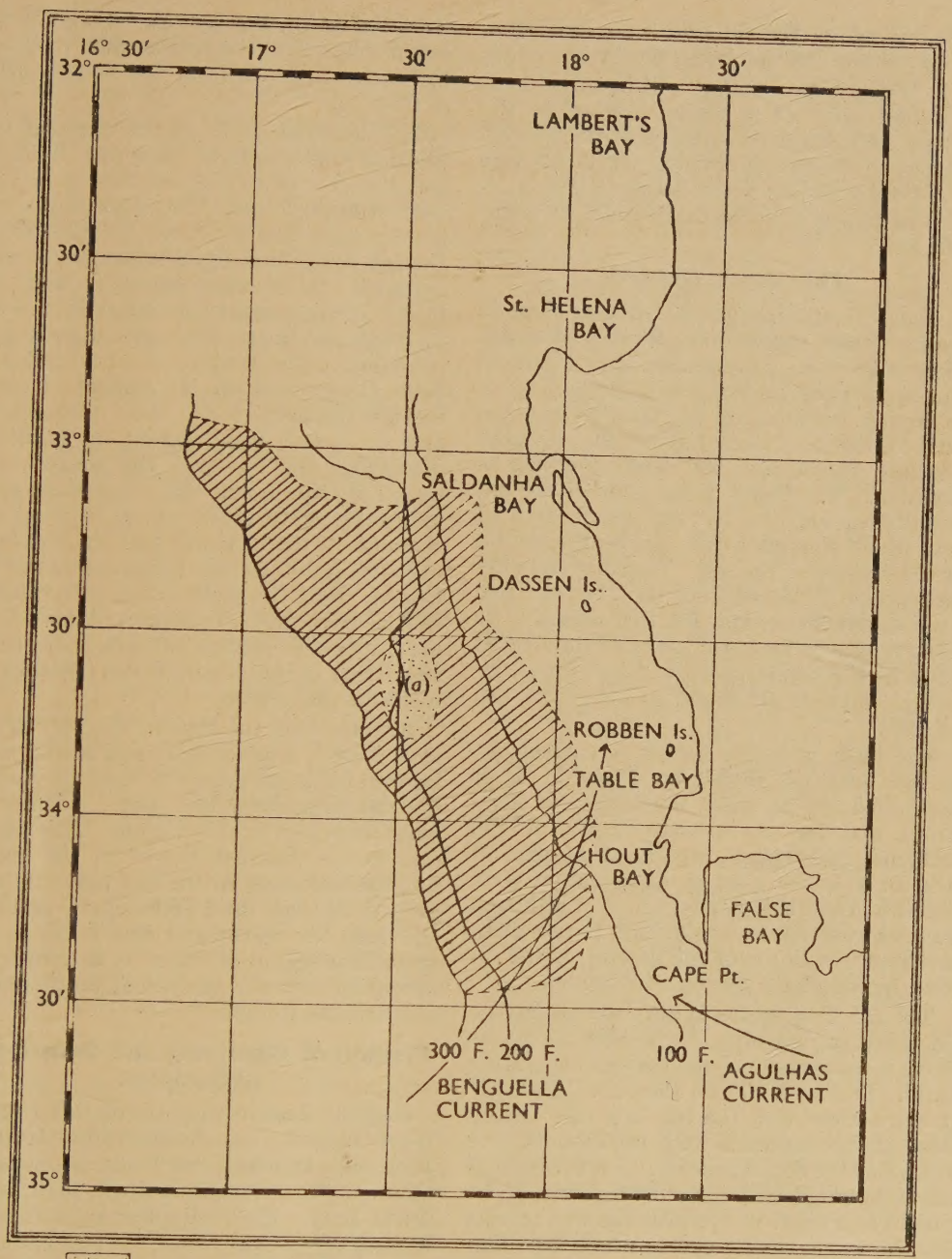


PLATE I.

(Taken from Division of Fisheries Analytical Charts, Nos. 1 and 2, 1931.)

size and age of the fish and some indication of migration and spawning might be found.

It is also hoped that it will be possible to continue work of a similar nature in the future, as a sound knowledge of the general biology of the fish of commercial importance and from trawling areas is essential if commercial fishing is to be carried out on scientific lines.

The West Ground.

One of the most important fishing areas in South African waters is the West or Stockfish Fishing-ground. It extends approximately from Cape Point northwards to Saldanha Bay in an area between the 100 fathoms and 300 fathoms depths. Plate I shows the surveyed trawling ground and the depth contours of the area. The limits of the ground are not determined entirely by the distribution of fish, which is much wider, but by the nature of the bottom of the sea. Trawling can only be successfully carried out on a bottom free from obstructions, and for this reason little or no fishing by means of the otter trawl takes place in the region south of Cape Point, although there is an abundant supply of fish present.

The most intensive fishing is carried out in the area (*a*) shown on Plate I. It is approximately 45 miles north-west of Cape Town and has an average depth of 185 fathoms. The largest number of samples of fish for stomach content examination were obtained from this particular area, although samples were obtained from both the northern and southern limits of the ground, as well as from intermediate stations throughout.

The trawling on the West Ground may be described as intensive all the year round, as there is an average of ten trawlers operating daily. During a trip on the S.T. "Protea" it was noticed that the trawling was usually done in an approximately north-south line and along the depth contour. For example, if the skipper felt that the most fish were to be caught at a depth of 170 fathoms on a certain day, he would steer a course which kept him at that depth, using the echometer for sounding at frequent intervals and turning towards shore if he found the depth increasing and away from shore if he found the depth decreasing. The average length of a drag was found to be two hours, and the hauls varied from half a ton of fish to 4 tons.

The water of the West Ground area is cold, being influenced by the Benguella current from the south, and a study of temperatures taken shows that the temperature average at 170 fathoms depth is in the neighbourhood of 6°–7° C.

The assumed paths of the Benguella and Agulhas currents have been put in Plate I, and the area of mixing appears to be south-west of Cape Point. This area of mixing is by no means clearly defined, but the fact that changes in the food organisms in, for example, stockfish (*Merluccius capensis*) and John Dories (*Zeus capensis*) do occur in this area, may indicate the presence of a slightly different fauna. The medium-sized stockfish and John Dories feed on *Myctophum* of various species throughout the West Ground, and only to a very small extent on *Maurolicus pennanti*. But towards the south, in the region of Cape Point, the *Myctophum* appear to be replaced to a great extent by *Maurolicus pennanti* in the stockfish and by *Maurolicus pennanti* and *Photichthys argenteus* in the John Dories. Both *Myctophum* and *Maurolicus* as well as *Photichthys* occur in the Atlantic, however, and the change may only be due to the nature of the ground which becomes very rocky in this region.

Reports from the trawler skippers indicate that there is a great deal more in the way of bottom fauna off Cape Point, as they usually find large amounts of "dirt" in their nets when trawling in this region. This may be due to the different nature of the bottom, i.e., the rockiness, or the fact that it is virgin ground and has been little fished, or that in this area the warm and cold currents meet to form a region of water of a temperature favourable for the growth of both cold and warm water forms.

Method of Obtaining and Constitution of Samples.

Regular weekly samples of fish from the West Ground were obtained from Irvin and Johnson's trawlers, with the assistance of their skippers, from 17th April, 1946, to 20th April, 1947. Each sample consisted of four baskets representative of the last haul made before returning to port. The number of fish contained in the four baskets was found to vary from 200–400, depending upon the size of the fish. The average number of fish in one sample was 200. During the course of the year's investigation 43 samples were examined.

The last haul made by the trawler usually takes place at midday or in the early after-

noon, and in each case the position and depth of the haul was taken by the skipper and sent in with the sample. The type of gear used in all cases was the otter trawl.

The West Ground fishes upon which food investigations have been made are as follows :—

1. *Merluccius capensis* (Castelnau)—the Cape Stockfish or Hake.

2. *Zeus capensis* (Cuvier and Valenciennes)—the Cape John Dory.

3. *Helicolenus maculatus* (Cuvier and Valenciennes)—the Sancord (or so-called Jacopever).

4. *Genypterus capensis* (Smith) — the Kingklip.

5. *Coelorhynchus fasciatus* (Günther)—the Banded or Large-scaled Rattail.

6. *Lionurus nigromaculatus* (McCulloch)—the Smooth Rattail.

These six species are amongst the most common in occurrence in this area. From the commercial point of view, the stockfish is the most important as a food fish, while the kingklip, although not nearly so common, is also a very important food fish because of the excellent quality of its flesh. The John Dory, although common in occurrence and a very good table fish, is not often sold for food because it becomes soft very rapidly, and is used, together with the two species of rattail, as material for fish meal.

Each sample was carefully examined and a list of the different species of fish and invertebrates made throughout the year. It was hoped in this way to obtain some idea of the general fauna of the area and also a check on possible migration.

Method of Dealing with Samples.

The sample of four baskets of fish was first sorted and the six species mentioned above separated. Each fish was then weighed on a spring balance and measured on a metre fish board. These two readings were then written down on a small label next to a symbol representing the specific name of the particular fish. Then a longitudinal incision was made along the ventral surface and the whole alimentary system and gonads removed. The liver was cut away and the label attached round the oesophagus so as to keep the stomach contents in. In this manner it was possible to remove the stomachs and gonads of a large number of fish in a comparatively small container.

It may be mentioned that all lengths were taken in centimetres from the tip of the snout to the end of the caudal peduncle and not to the end of the tail. It was found that measurement to the tip of the caudal peduncle was far more satisfactory, due to the fact that caudal fins were very often snapped off or badly damaged in the trawl. The weights taken were in pounds and ounces and were converted into grammes.

Immediately after removal the stomachs and gonads were placed in a 10 per cent. solution of formalin for preservation and also to prevent any further action of the digestive processes.

To complete a sample was found to take on an average two and a half hours with three people working.

The following morning the stomachs were examined in the laboratory. In each case the name, length and weight of the fish was recorded from the label, the stomach opened and the contents carefully washed out into a petri dish with tapwater. In this way the form of partly digested organisms was more easily seen. All recognizable organisms were identified and their names recorded, while organisms which were not known but in a state fit for recognition were preserved in specimen tubes. The gonad was also weighed and the weight, sex and condition of ova or milt recorded.

Sources of Error and Difficulties.

As may well be imagined, an arrangement for obtaining samples such as these does not always work perfectly. Incorrect samples were sometimes collected due to the fact that the skipper of the trawler was changed. For example, the sample obtained was not a true representation of the catch and a certain amount of sorting had been carried out by the crew.

Bad weather often made it extremely difficult and sometimes impossible to get samples. Even good fishing was a drawback at times, as the last haul was so large that the sample was forgotten.

As far as the fish themselves were concerned, their habit of snatching while in the trawl net was a factor to be guarded against. It appears that in the general turmoil and panic of being tumbled about in the net many of the fish snatch at and swallow anything which comes their way. This was found to apply particularly to stockfish and *Helicolenus maculatus*. Therefore, in order to avoid any

incorrect recordings of stomach contents, any recently swallowed organism found in the stomach was discounted as an article of normal diet.

Another habit of trawl-caught fish is that of everting their stomachs. This happens particularly in stockfish (*Merluccius capensis*) and Smooth Rattails (*Lionurus nigromaculatus*) and may be due to nervous reaction or to the rapid change in pressure on being handled from depths of as much as 220 fathoms to the surface. It is interesting to note, however, that line-caught stockfish from shallower waters have also been found to evert their stomachs and protrude them through their mouths. As there is little pressure change here it seems probable that the eversion habit is due to fear.

The process of digestion makes the recognition of organisms found in the stomach very difficult. The last haul is usually made in the middle of the day and the stomachs are removed and placed in 10 per cent. formalin between 8 p.m. and 11 p.m. that evening, so that an organism eaten just before the fish was caught has been affected to some extent at any rate by digestive processes for approximately eight hours. Nevertheless, once some of the food organisms were properly identified, it was found possible to recognise them from single appendages in the case of crustacea, and other parts, such as otoliths, in the case of fishes.

The large size of the meshes of the otter trawl net is another factor which limits the size of organisms collected. Thus, a high proportion of all organisms below a certain size pass through the net, so that the lists of organisms comprising the West Ground fauna tabled hereafter is by no means a complete one. The size of the mesh of the cod-end of a standard otter trawl net is 4 inches stretched, but when the net is towed, the apertures of the mesh become slightly closed. In spite of this a large number of the smaller fish and other organisms will pass through the net. During hauls made on the S.T. " Protea ", it was noticed that large numbers of juveniles of *Coelorhynchus fasciatus*, of lengths approximately 100 mm., were caught in almost every haul. These were probably caught as a result of the jamming up of fish at the cod-end of the trawl net.

Also, very little of the bottom fauna seems to be removed by the net as it is dragged. At times it does dig in, and large numbers of Hermit Crabs (*Parapagurus dimorphus*), starfish of various species, and Seapens (*Anthoptilum grandiflorum*), are brought up. The fact that this area is so intensively dragged must have caused a considerable depletion in the numbers of bottom living organisms.

Finally, the period of one year's investigation is only long enough to give an indication of the general fauna, the organisms comprising the food and general conditions in this area. And it is only after similar work extending over a number of years has been done that anything like a complete picture will be obtained.

Identification of Organisms.

When the examination of samples was first started, records were made on the occurrence of various parts of organisms. For example, the flattened chelae of the bottom-living crab (*Mursia christimanus*) were found in stomachs for some months before a complete animal was obtained and properly identified. But once the identification was made, all the recordings became valid.

After a few months the food organisms of particular species became familiar and it was more or less known what to expect.

In identification of fishes in stomach contents, the otoliths were often of great value. If the process of digestion was far advanced, there was no chance of recognizing the fish from the usual external characters, but if the otoliths were present they were compared with those of known fish, and so their identity was established.

Crustacean eyes were found to be very resistant to the action of digestion and often remained when the rest of the organism was completely digested. But no identification system utilizing the eyes was used, although it is quite possible that one could be evolved.

Fauna of the West Ground.

As has been mentioned, a list of fish and invertebrates in each sample was made throughout the year. During a trip on the S.T. " Protea " in November, 1946, a list of fish and invertebrates was made for every haul. So, apart from the small fish and other organisms which pass through the trawl-net meshes, there should be some indication of the relative abundance of a large number of the fauna of this area.

The following table shows the various species of fish encountered throughout the year with very brief notes on periodic occurrence and relative abundance.

TABLE I.

FISH FAUNA OF WEST GROUND.

Family.	Genus and Species.	Common Name.	Occurrence.
1. GADIDAE.....	*Merluccius capensis*.....	Stockfish.....	Throughout the year.
	Lepidion capense.....	—	5 specimens in September, 1946
	Tripterophycis gilchristi ..	Gilchrist's Triple-fin	1 specimen in October, 1946.
2. CORYPHAENOIDINAE.	*Coelorhynchus fasciatus*..	Banded or Large-scaled Rattail	Common throughout the year.
	Lionurus nigromaculatus.	Smooth Rattail...	Common throughout the year.
3. OPHIDIIDAE.....	*Genypterus capensis*.....	Kingklip.....	Small numbers throughout the year.
4. CONGRIDAE.....	*Congermuraena albescens.*	White conger.....	5 specimens in August, October and November, 1946.
5. ZEIDAE.....	*Zeus capensis*.....	Cape John Dory..	Common throughout the year.
	Cyttus mccullochi	Australian Dory..	New species. 2 specimens in October, 1946.
6. SCORPAENIDAE.....	*Helicolenus maculatus*...	Sancord.....	Varying numbers throughout the year.
7. TRICHIURIDAE.....	*Lepidopus caudatus*.....	Scabbardfish.....	4 specimens in July, 1946.
8. BRAMIDAE.....	*Brama raii*	Sea-bream or Angelfish	Obtained in August, September and October, 1946.
9. CONGIOPODIDAE.....	*Congiopodus spinifer*....	Spiny horsefish...	2 specimens in October, 1946
10. CARANGIDAE.....	*Trachurus trachurus*.....	Maasbanker.....	Obtained from October, 1946 –April, 1947.
11. STROMATEIDAE.....	*Centrolophus niger*.....	—	1 specimen obtained, 2.4.47.
12. LOPHIIDAE.....	*Lopius piscatorius*.....	Angler.....	Common all the year round.
13. SCYLLIORHINIDAE...	*Scylliorhinus capensis*...	Cape Dogfish.....	Common all the year round.
	Scylliorhinus regani.....	Mottled Dogfish..	Obtained throughout the year.
14. SQUALIDAE.....	*Squalus acutipinnis*.....	Common Spiny Dogfish	Common thoughout the year.
	Squalus acanthias.....	European Spiny Dogfish	Small numbers throughout the year.
15. RAIIDAE.....	*Raia lintea*.....	Sharp-nosed Skate	Obtained in small numbers intermittently.
	Raia marginata	Long-nosed Skate	Very occasional.
16. HEPTRANCHIDAE....	*Heptranchias pectorosus*..	Seven-gilled Shark	2 specimens in February, 1947.
17. TORPEDINIDAE.....	*Narke capensis*	Electric Skate....	Very occasional.
18. MACRORHAMPHOSIDAE	*Notopogon macrosolen.*	Long-snouted Bellows-fish	1 specimen in December, 1946.
19. SERRANIDAE.....	*Polyprion americanus*....	Stonebass.....	Small numbers throughout the year.

Below is a list of fishes of smaller size which have been found amongst stomach contents and which must, therefore, be an important part of the fauna of this area.

TABLE 2.

FISH FAUNA OF WEST GROUND.

Family.	Genus and Species.	Common Name.	Occurrence.	Found in Stomach of :—
STOMIATIDAE...	*Argyropelecus hemigymnus*	—	Occurred in Aug. and Sep., 1946, in small numbers	*Zeus capensis, Helicolenus maculatus.*
	Argyropelecus olfersi	—	Six specimens in Feb., 1947	*Zeus capensis.*
	Photichthys argenteus	—	Small numbers in Oct. and Nov., 1946	*Zeus capensis.*
	Maurolicus pennanti	—	Small numbers throughout the year	*Zeus capensis, Helicolenus maculatus, Merluccius capensis.*
MYCTOPHIDAE..	*Myctophum humboldti*	—	Common throughout the year	*Zeus capensis, Brama raii, Merluccius capensis, Helicolenus maculatus, Coelorhynchus fasciatus.*
	Myctophum coccoi	—	Occasional throughout the year.	—
CALLIONYMIDAE	*Paracallionymus costatus*	Cape Dragonet	Present throughout the year.	*Helicolenus maculatus, Coelorhynchus fasciatus, Genypterus capensis.*
PARALEPIDAE...	*Paralepis* sp....	—	5 specimens in Jan., May and Aug., 1946	*Merluccius capensis.*
BOTHIDAE.....	*Arnoglossus* sp..	—	1 specimen.....	*Helicolenus maculatus.*
GADIDAE.....	*Tripterophycis gilchristi*	Gilchrist's Triplefin	1 specimen in Dec., 1946..	*Helicolenus maculatus.*
SCORPAENIDAE..	*Helicolenus maculatus* (juv.)	Sancord...	6 specimens in Dec., 1946.	*Helicolenus maculatus, Genypterus capensis.*

EXTRA NOTES ON SOME OF THE SPECIES MENTIONED ABOVE.

Lepidion capense.—Five specimens were caught in the otter trawl on the West Ground. Stomach contents were examined and one female contained a single Hermit Crab (*Parapagurus dimorphus*). So it would seem that this species feeds on the bottom.

Tripterophycis gilchristi.—Only one specimen was obtained in October, 1946, but occasionally small individuals were found amongst stomach contents.

Congermuraena albescens.—Five of these were obtained in August, October and November, 1946, and Dr. Barnard of the South African Museum remarked on the appearance of the skin which is covered with hairlike papillae giving the surface a furry texture. As far as is known, previous descriptions have been made from long preserved specimens, but this characteristic has not been mentioned.

Cyttus mccullochi.—Two of these fish occurred during October, 1946, both males, and none has occurred since. A joint description has been written by Barnard and Davies and has been published in the Annals and Magazine of National History. A first description of this new species was published by Whitley ("Australian Zoologist" Vol. II, Part 2, July, 1947). The fish appears to have affinities with both the Cyttine and Zeine groups in the family Zeidae.

Brama raii.—Although these fish were only obtained during August, September and October, it seems very probable that they are present in small numbers all the year round. Being an excellent food fish, any which are caught in the last trawl are almost certainly taken by members of the trawler crew for "frys". Nevertheless, this fish is never very common on this ground at any time of the year.

Centrolophus niger.—Only one specimen was obtained during the year of investigation. It is called a "Leervis" by members of the trawler crew, but it is in no way related to the fish usually called by that name (*Lichia amia*). This specimen was obtained in April, 1947, was a female and was approximately 900 mm. in length.

Lophius piscatorius.—Angler fishes or Monks of various sizes were obtained in samples throughout the year.

Heptranchias pectorosus.—Only two specimens were obtained, both females, in February, 1947.

Note on *Paralepis* sp.

A total of 5 specimens of *Paralepis* sp. was obtained on three occasions in January, May and August, 1946, from stockfish stomachs. Unfortunately on each occasion the fish had advanced far in the process of being digested and it was only by careful examination of all the specimens that the characteristic features of a single fish could be established. Dr. Barnard examined the fish and stated that there is a very strong possibility of their being representative of the genus *Paralepis*, in which case they are first recordings from this area.

Note.—Further notes on the occurrence of these fish as stomach contents will be found under the headings of the fish by which they were consumed.

Invertebrate Fauna.

On the following page is a list of the invertebrate fauna which was obtained from samples throughout the year. It consists mostly of bottom fauna, but various pelagic forms, such as octopus and squids (*Loligo*), have also been included. A further list of invertebrate fauna found in stomachs is given after this fauna list.

TABLE 3.

INVERTEBRATE FAUNA OF WEST GROUND.

Phylum, Class, Order, etc.	Genus and Species.	Occurrence.
PORIFERA	Fibrous sponge	Occasional throughout the year.
	Hexactinellid sponge	Occasional throughout the year.
	Protoleia sp.	1 specimen: October, 1946; growing on *Argobuccinum murrayi.*
COELENTERATA	*Actinostola capense*	Occasional throughout the year.
	Anthoptilum grandiflorum	Common throughout the year.
	Bolocera capensis	Common throughout the year.
	Melitodes dichotoma	Rare—1 specimen in September, 1946.
ECHINODERMATA (ASTEROIDEA)	*Ceramaster chondriscus*	Occasional throughout the year.
	Chondraster elattosis	Occasional throughout the year.
	Crossaster penicillatus	Occasional throughout the year.
	Dipsacaster sladeni	Common throughout the year.
	Henricia abyssalis	Rare—1 specimen in November, 1946.
	Hippasteria phyrgiana (var. 1)	Common throughout the year.
	Hippasteria phyrgiana (var. 2)	Common throughout the year.
	Luidia sp.	Rare—1 specimen in November, 1946. (More common further north.)
	Mediaster capensis	Occasional throughout the year.
	Perissasterias polyacantha	Rare—3 specimens, 1 in August, 2 in October.
	Pteraster capensis	Occasional throughout the year.
	Tosia tuberculata	Very common throughout the year.
(OPHIUROIDEA)	*Gorgonocephalus chilensis*	Rare—2 specimens in September, 1946.
	Ophiura costata	Present all the year round.
	Ophiura sp.	Common all the year round.
(ECHINOIDEA)	*Paracentrotus grandis*	Rare—2 specimens during the year.
ANNULATA (CHAETOPODA) Polychaeta	*Chloeia gilchristi*	Rare.
	Euphione elisabethae	1 specimen: 4.9.46.
ARTHROPODA (CRUSTACEA). Decapoda	*Eupagurus* sp.	Occasional throughout the year.
	Exodromidia spinosa	1 specimen: November, 1946.
	Geryon quinquedens	1 specimen: March, 1947.
	Mursia christimanus	Common throughout the year.
	Parapagurus dimorphus	Common throughout the year.
	Parapagurus pilosimanus	1 specimen: July, 1946.
	Pilumnoplax heterochin	Rare.
	Scyramathia hertwigi	Occasional throughout the year.
MOLLUSCA (GASTROPODA)	*Argobuccinum murrayi*	Occasional throughout the year.
	Fasciolaria surtila	Rare—1 specimen in October, 1946.
	Neptuneopsis gilchristi	Occasional throughout the year.
(CEPHALOPODA)	*Loligo reynaudi*	Common throughout the year.
	Octopus sp.	Occasional throughout the year.

TABLE 4.

INVERTEBRATE FAUNA FROM WEST GROUND—STOMACH CONTENTS.

Note.—This table is supplementary to Table 3.

Phylum, Class, Order, etc.	Genus and Species.	Occurrence.
ECHINODERMATA (OPHIUROIDEA)	*Ophiomyxa vivipara*	1 specimen in August, 1946.
	Ophiura sp.	Specimens in February, July, August, September, October.
(CRINOIDEA)	*Crinoid antedon* sp.	Specimens in June and October.
ANNULATA (CHAETOPODA) Polychaeta	*Chloeia gilchristi*	Specimens obtained in February, May, June July, August, October, November.
ARTHROPODA (CRUSTACEA). Mysidacea	*Gnathophausia* sp.	This and other unidentifiable species obtained mainly in January but occasionally throughout the year.
Isopoda	*Rocinela dumerilii*	August, February—2 specimens.
Amphipoda	*Hyperia* sp.	5 specimens in January, April and December.
Euphausiacea	*Euphausia similis*	Sporadic throughout the year.
	Thysanopoda distinguenda	Sporadic throughout the year.
Decapoda	*Funchalia woodwardi*	Small numbers in January, February, March, June, July, November, December. Peak months, December–January.
	Leontocaris paulsoni	Specimens in September, October, November, December, 1946.
	Megalopa crab larva	1 specimen.
	Mursia christimanus	January, February, June, September, October, December.
	Pagurus sp. (juveniles)	Specimens in January, February, May, June, July, October.
	Pilumnoplax heterochin	Specimens obtained in July and September.
	Sergestes armatus	October, 1946—1 specimen.
	Solenocera sp.	Small numbers in January, February, March, June, July, November, December. Peak months, December–January.
Stomatopoda	*Squilla armata*	Specimens in February, May, July, October, 1946. Probably present throughout the year.
MOLLUSCA (GASTROPODA)	*Hyalaea tridentata*	Large numbers obtained in December, 1946, only.
(CEPHALOPODA)	*Loligo reynaudi*	Common throughout the year.
	Octopus sp.	Specimens obtained in June, November, October.
PROTOCHORDATA	*Pyrosoma* sp.	Specimens obtained in December, 1946, and January, 1947.
	Salpa sp.	Specimens obtained in August, September, October, 1946.

All the organisms listed in Table 4 were obtained from stomachs of various species of fish characteristic of this area, and since none was very far advanced in the process of digestion, it is considered that they are likely to be normal members of the fauna of the West Ground and have therefore been included in a supplementary list.

The recordings showing the various months in which they occurred may indicate to some extent the fluctuation of numbers of these

organisms throughout the year, but in such a short period of observation little could be based on such times of occurrence.

Brief Note on Bottom Sample from West Ground in November, 1946.

During trawling from the S.T. " Protea " in November, 1946, the net dug into the bottom one day and a large amount of green sand containing various organisms was brought up. This particular drag was made in a position 45 miles north west of Cape Town at a depth of 180 fathoms, that is, in a position from which the majority of samples was obtained throughout the year's investigation and in the area (*a*) Plate I. When the cod-end of the trawl net was emptied on to the deck, the material was carefully examined and the organisms sorted out. The following list of organisms was obtained and may give some indication of the bottom fauna of the area.

TABLE 5.

BOTTOM SAMPLE FROM THE WEST GROUND.

Phylum, Class, Order, etc.	Genus and Species.	Abundance in Trawl.
COELENTERATA.....	*Actinostola capense*.....	Few.
	Anthoptilum grandiflorum....	Numerous.
	Bolocera capensis.....	Numerous.
ECHINODERMATA.....	*Dipsacaster sladeni*.....	Numerous.
	Ophiura sp.....	16 specimens.
	Perissasterias polyacantha....	1 specimen.
	Pieraster capensis.....	3 specimens.
	Tosia tuberculata.....	Numerous.
ARTHROPODA (CRUSTACEA)..... Decapoda	*Parapagurus dimorphus*.....	Very numerous.
	Scyramathia hertwigi.....	4 specimens.
MOLLUSCA.....	*Argobuccinum murrayi*.....	Numerous.

Food of Merluccius Capensis (Castelnau), the Cape Stockfish.

General.

The question as to whether the Cape stockfish is a distinct species from the North Atlantic *Merluccius vulgaris* is still undecided. *Merluccius vulgaris* is found to be distributed, according to depth, from the North Sea southwards round the coasts of France, Spain and North Africa as far south as latitude 15° N., while *Merluccius capensis* extends from Durban round the Cape as far north as 10° S. No recordings of stockfish between 15° N. and 10° S. are available, but it is possible that the gap in their distribution is smaller than this.

According to descriptions of the two species, there is little difference between them and only careful comparison of large numbers may yield some constant differential features.

It appears that the Cape stockfish is almost entirely a pelagic feeder, and, judging from its behaviour in relation to trawling, feeds during the night near the surface and rests near the bottom during the day. Large numbers of stockfish are caught in the otter trawl nets at depths in the neighbourhood of 200 fathoms (366 metres) during the day by commercial trawlers, while a long drag at night will generally yield very few fish. Line fishermen working at night, however, often catch stockfish very near the surface.

The habit of snatching at any object in the trawl net has already been mentioned, and any freshly swallowed organism has been

discounted as an article of normal diet of the stockfish.

Due to the large size of the regulation trawl net meshes, the smallest fish obtained have been those of length 200 mm., and young fish below this length have therefore not been examined for stomach contents. A few smaller fish obtained from large stockfish were examined and in one case large numbers of Mysids were found. The largest fish which occurred during the period of investigation was one of length 1,040 mm.

In Table 6 the stockfish have been divided up into arbitrary length categories 100 mm. apart. It is hoped in this way to cover change of diet due to increase in size. According to Roux (op. cit.), the average growth of a stockfish is approximately 100 mm. per year, so that the length categories are probably not unreasonable.

Amongst the food organisms, species have been classed together into genera in certain cases, the reasons being, firstly, that in many cases the process of digestion was so far advanced as to make the various species indistinguishable while it was still possible to recognize the genus. This was found to be the case in the fish genus *Myctophum*, in which the basis of classification of the species is mainly the distribution of the photophores which rapidly became obliterated by the action of digestion. So, although a fish clearly belonged to the genus *Myctophum*, any further definition into species was very difficult and sometimes impossible. Secondly, a much better general impression of the diet of the stockfish is obtained when a number of species is placed together under the heading of one genus.

Food, i.e. stomach content, observations were made over a period of 12 months from weekly samples. During this period from April, 1946, to April, 1947, a total of 1,789 stockfish were examined, all of which came from the West Ground in the Atlantic Ocean. No stockfish were examined from the Indian Ocean, but it is hoped that in the future it will be possible to undertake the examination of a similar number from the east coast and that a comparison can be made.

Altogether 19 different organisms were found in stockfish stomachs. Rattray (op. cit.) found a total of 19 different organisms as well, and in general the two lists are the same.

The main food of the stockfish was found to consist of :—

1. Euphausiacea—*Euphausia* sp., *Thysanopoda* sp.
2. Mysidacea.
3. Myctophidae — *Myctophum humboldti*, *Myctophum coccoi*.
4. Stomiatidae—*Maurolicus pennanti*.
5. Cephalopoda—*Loligo reynaudi*.
6. Coryphaenoididae — *Coelorhynchus fasciatus*.
7. Gadidae—*Merluccius capensis*.

In Table 6 is seen a complete list of food organisms found during the year in the various length categories.

Examination of the table shows that the food organisms which are most important in relation to the smaller sizes of stockfish are Euphausiacea, Myctophidae and Mysidacea. Almost half the normal diet of small stockfish throughout the year consists of various genera of Euphausiacea, such as *Thysanopoda* and *Euphausia*, while roughly one-third consists of *Myctophum humboldti* and *Myctophum coccoi*. Then in decreasing order of importance are found Mysidacea, Cephalopoda, Stomiatidae, Decapoda, stockfish, *Coelorhynchus fasciatus* and Amphipoda.

Plate II, Fig. 1 shows the approximate relative importance of food organisms in small- and medium-sized stockfish in length category 200–600 mm.

Table 6 also shows that the food organisms vary considerably with the increase in size of the stockfish. Large and medium stockfish are seen to feed to a very great extent on smaller members of their own species, throughout the year. *Trachurus trachurus*, the maasbanker, constitutes a fairly important article of diet for the larger stockfish, but only at certain times of the year. *Coelorhynchus fasciatus* and Euphausiacea form equally important food organisms throughout the year, while *Loligo reynaudi*, *Myctophum humboldti* and *Myctophum coccoi*, together with *Maurolicus pennanti*, comprise the other main food organisms.

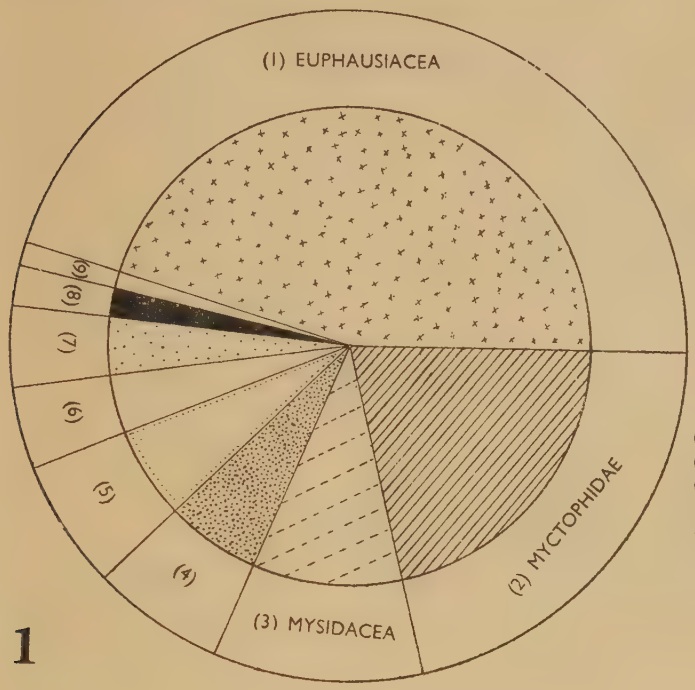
Plate III, Fig. 1, shows the approximate relative importance of food organisms in medium- and large-sized stockfish in length category 600–1,040 mm.

For convenience the stockfish have been divided into two length categories for representation in the Plates, but from Table 6 it

TABLE 6.—FOOD ORGANISMS IN *MERLUCCIUS CAPENSIS*.

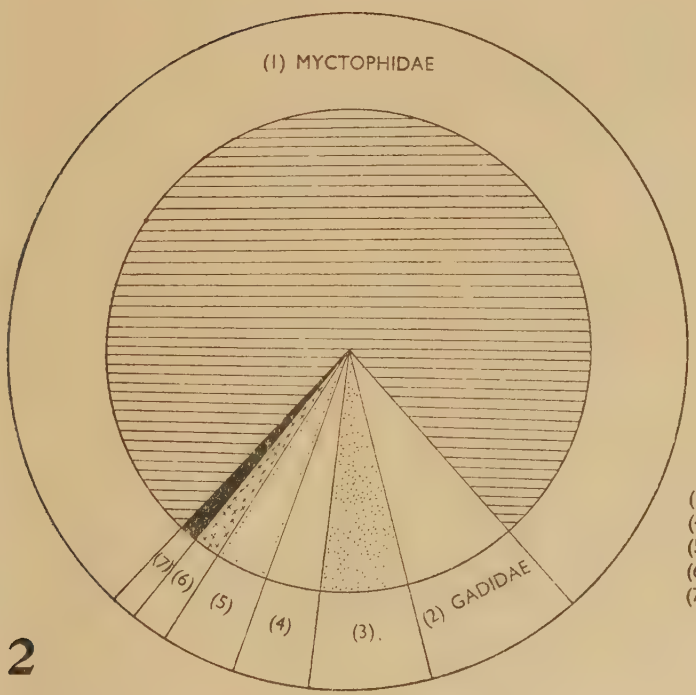
Length Categories in Millimetres.	Amphipoda Hyperia sp.	Decapoda Solenocera sp. Funchalia woodwardi.	Decapoda Aegeon lacarzei.	Decapoda Megalopa crab larvae.	Decapoda Squilla armata.	Euphausiacea Euphausia sp. Thysanopoda sp.	Mysidacea.	Crustacean Remains Unidentifiable.	Cephalopoda Loligo reynaudi.	Pteropoda Hyalaea tridentata.	Myctophidae Myctophum humboldti Myctophum coccoi.	Stomiatidae Maurolicus pennanti.	Gadidae Merluccius capensis.	Coryphaenoididae Coelorhynchus fasciatus.	Paralepidae Paralepis sp.	Fish Scales.	Fish Remains Unidentifiable.	Carangidae Trachurus trachurus.	Numbers of Merluccius capensis found Empty.	Numbers of Merluccius capensis Examined.
200–299.	1 (2)	—	—	—	—	14†	5†	—	—	—	3 (5)	2 (5)	—	—	—	1	4 (4)	—	73	103
300–399.	1 (2)	1 (1)	1 (1)	1 (1)	—	49‡	9†	—	2 (2)	—	23 (79)	2 (5)	2 (2)	2 (4)	1 (3)	—	11 (14)	—	281	390
400–499.	—	5 (10)	—	—	1 (1)	48‡	17†	—	10 (11)	—	38 (111)	11 (22)	4 (4)	—	2 (2)	—	23 (32)	—	533	616
500–599.	1 (1)	7 (11)	—	—	—	22†	5†	1 (1)	7 (7)	1 (1)	7 (13)	6 (9)	6 (6)	3 (3)	—	2	14 (19)	1 (1)	269	428
600–699.	—	—	—	—	—	3†	—	—	2 (2)	—	2 (8)	1 (1)	7 (8)	—	1 (1)	1	—	—	92	108
700–799.	—	1 (1)	—	—	—	1†	—	—	—	—	—	—	14 (16)	2 (2)	—	—	3 (4)	2 (2)	50	73
800–899.	—	—	—	—	—	—	—	—	—	—	—	—	10 (13)	2 (2)	—	—	—	4 (5)	24	39
900–1040	—	—	—	—	—	—	—	—	—	—	—	—	15 (21)	1 (1)	—	—	3 (3)	4 (4)	11	32
																		Totals	1,333	1,789

NOTE:—In tables 6 to 11—* = Few, † = Numerous, ‡ = Very numerous. Numbers in brackets indicate numbers of organisms found. Thus 7 (13) means that a total of 13 organisms was found in 7 fish.



(4) CEPHALOPODA
(5) STOMIATIDAE
(6) DECAPODA
(7) GADIDAE
(8) CORYPHAENOIDIDAE
(9) AMPHIPODA

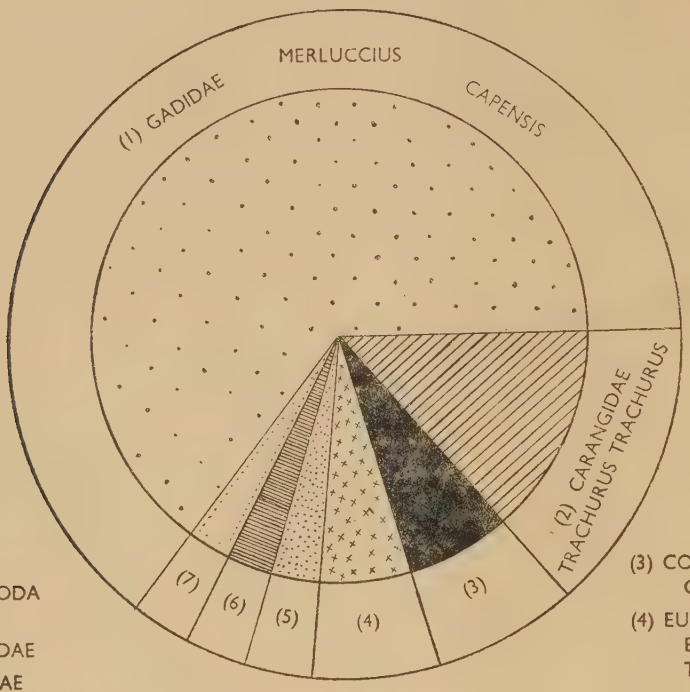
1



(3) CEPHALOPODA
(4) DECAPODA
(5) STOMIATIDAE
(6) EUPHAUSIACEA
(7) CORYPHAENOIDIDAE

2

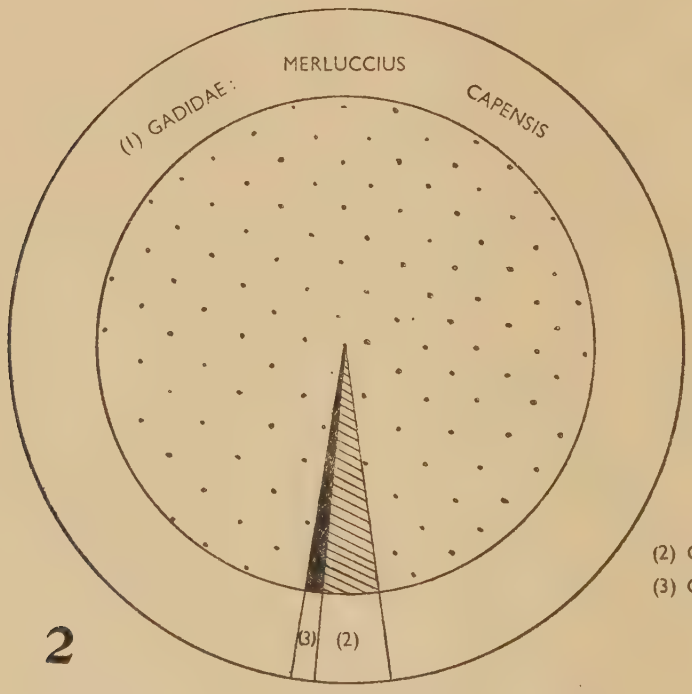
PLATE II.



1

(5) CEPHALOPODA
Loligo
(6) MYCTOPHIDAE
(7) STOMIATIDAE

(3) CORYPHAENOIDIDAE
Coelorhynchus fasciatus
(4) EUPHAUSIACEA
Euphausia sp.
Thysanopoda sp.



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(2) CARANGIDAE
(3) CORYPHAENOIDIDAE

PLATE III.

seems evident that stockfish from lengths of 700 mm. upwards feed almost exclusively on smaller members of their own species, together with smaller numbers of *Coelorhynchus fasciatus*, throughout the year. But during certain months this diet is supplemented with *Trachurus trachurus*, i.e., from October to April, when maasbankers are present in large numbers on the West Ground.

The Food Organisms found in Merluccius Capensis.

Each food organism may now be considered individually in relation to its taxonomy, occurrence throughout the year and importance as a food of the stockfish.

A.—Crustacea.

Amphipoda.

During the whole year only five specimens of Amphipoda belonging to the genus *Hyperia* were obtained from stockfish stomachs. They occurred in stockfish ranging in size from 200–600 mm. in length, during the months January and April. It seems, therefore, that they are an unimportant article of diet and are probably only eaten by chance.

Euphausiacea.

Euphausia similis and *Thysanopoda distinguenda* were found in large numbers throughout the year in stockfish stomachs. They appear to form by far the most important organism of diet in stockfish of length category 300–600 mm., but are found very frequently in stockfish ranging from 200–800 mm. in length.

Euphausiacea were recorded in stomach contents during every month of the year, and were found to make up approximately 46 per cent. of the general diet of the stockfish examined in length category 200–600 mm.

Mysidacea.

Mysidacea of the following species, *Gnathophausia* sp. and others unidentifiable due to digestive action were found in stomachs of stockfish in length category 200–600 mm., but regular monthly recordings were not obtained. January was found to be a month of high incidence of Mysids, but it is quite possible that the few recordings during the rest of the year are not due to the absence of the Mysids, but due to the fact that these small organisms rapidly became reduced to a completely unrecognizable mass by digestive action.

Decapoda.

(*a*) *Prawns.*—Prawns of the species *Solenocera* sp. and *Funchalia woodwardi* were recorded in stockfish in length category 300–800 mm. during some months of the year. Their occurrence appears to be partly seasonal, as fair numbers were obtained from January to April, but otherwise only in November. In nearly all cases digestion was far advanced, and the two genera *Solenocera* and *Funchalia* were indistinguishable, but generally *Funchalia woodwardi* seemed more frequent in occurrence.

It appears that when the prawns are available, the stockfish of medium size feed on them to a marked degree, and as many as six large *Funchalia woodwardi* have been found in the stomach of a stockfish of length 490 mm.

The appearance of these prawns is sporadic, and were they present in the West Ground area throughout the year, it seems very likely that they would constitute an important food organism of the fish fauna in general.

(*b*) *Megalopa* larva.—A single megalopa stage crab larva was found in a stockfish. It was found impossible to identify the larva. No other recordings have been obtained from stockfish stomachs.

(*c*) *Shrimps.*—On one occasion a female *Sergestes armatus* (Kioyer) was found in a female stockfish of length 470 mm. in January.

(*d*) A single specimen of *Aegeon lacarzei* was found in a stockfish of length 382 mm. in April.

It appears therefore that these shrimps are only chance food organisms and do not make up an important item in the general stockfish diet.

Stomatopoda.

Only one Stomatopod, viz., *Squilla armata*, was found during the whole year, so that it may be concluded that it is not a normal food organism for stockfish, although large numbers are present in the West Ground area. Squilla normally lives on the bottom, however, and since stockfish are pelagic feeders it is not surprising that few are found amongst stomach contents.

B.—Mollusca.

Cephalopoda.

Cephalopoda, mostly *Loligo reynaudi*, but occasionally small *Octopus* sp., were found in

stockfish throughout the year. They are eaten most frequently by stockfish between lengths 400–600 mm., but have been found in fish between 300–700 mm. in length. It may be said that 6 per cent. of the general diet of the stockfish examined from 300–600 mm. consists of Cephalopoda.

Very often only beaks and eyes were found, but apart from *Loligo*, only a few small *Octopus* sp. were found. In agreement with Rattray's peak period from January to March, a higher incidence of *Loligo* in stomachs was found during that period.

Pteropoda.

Pteropod molluscs were recorded only once during twelve months' investigation, and a single specimen of *Hyalaea tridentata* was found in the stomach of a stockfish of length 570 mm. Other specimens were found in *Trachurus trachurus* at the same time, i.e., during December.

It appears that these are chance food organisms and, when available, are eaten by the stockfish.

C.—Pisces.

Myctophidae.

Young and adult fishes of the family Myctophidae were found to be important food organisms in stockfish diet in length category 200–700 mm., but were most important for fish between 300–600 mm. in length. It may be said that approximately 21 per cent. of the diet of stockfish up to 600 mm. in length examined is made up of *Myctophum* and that they are eaten throughout the year.

Two species of *Myctophum* were found, viz., *Myctophum humboldti* and *Myctophum coccoi*, the former being much more frequent in occurrence. The *Myctophum* found in stomachs were nearly always half-grown, and comparatively few adults were recorded. In most cases it was very difficult to identify the *Myctophum* down to species, as the digestive process had advanced too far.

Stomiatidae.

The small fish *Maurolicus pennanti* was found to be present as a food organism in stockfish of length range 200–700 mm., but its appearance was sporadic, and seemed to be more frequent in the southern region of the West Ground in the neighbourhood of Cape Point. It was found to comprise approximately 6 per cent. of the food of stockfish in length category 200–600 mm. examined.

It may be said to be a fairly important food organism, but is apparently not always available.

Gadidae.

Investigation has shown that stockfish from 300 mm. length upwards feed on smaller members of their own species to a very great extent. While smaller stockfish were found to comprise approximately 4 per cent. of the general diet of stockfish examined between lengths 200–600 mm., they were found to make up 65 per cent. of the diet of stockfish examined between 600–1,040 mm. in length.

There is a widespread belief that fishes are not cannibalistic, but the stockfish may be taken as an example in which by far the most important article of diet is stockfish, and these are probably by far the most suitable of all the food organisms.

Coryphaenoididae.

Coelorhynchus fasciatus juveniles and adults were found in stockfish in the length category from 300–1,040 mm. throughout the year. They were found to comprise 2 per cent. of the general diet of stockfish examined in the length category 200–600 mm. and 7 per cent. in length category 600–1,040 mm.

Since small *Coelorhynchus fasciatus* are present all the year round they probably form an important item of diet of the stockfish of medium and large sizes. They were thought to be the main food organism, but this is apparently not correct.

Paralepidae.

On three occasions possible *Paralepis* sp. were found in stockfish stomachs, in all a total of five specimens. But in all cases the process of digestion was so far advanced as to make recognition of parts almost impossible, and it was only by careful examination of all the fish that the characteristics of a single fish could be established. Dr. Barnard was responsible for the identification of these fish, and these 5 specimens represent new recordings for the South Atlantic region. It is hoped that a more complete specimen may be found.

Paralepis is of little or no importance as a food organism to the stockfish.

Carangidae.

Although the first appearance of *Trachurus trachurus* in the trawl was recorded on 2nd October, none was found to have been eaten

by larger stockfish until 2nd April. April was a peak month as far as recordings in stockfish stomachs are concerned. Maasbankers were found only in the stomachs of large stockfish, i.e., those over 540 mm. in length, and were all adult.

Later qualitative examination of many large stockfish at sea showed that maasbankers formed a very important article of diet, and as many as 3 large maasbankers were found in a single stockfish stomach.

Trachurus trachurus may therefore be said to be an important seasonal food organism of large stockfish.

Scales.

In certain cases fish scales were found in stockfish stomachs, and were generally found to belong to *Merluccius capensis*, showing that either smaller stockfish had been eaten or that the fish had been biting each other and that the scales were thus removed. The latter explanation seems to be a more likely one as in most cases only a clump of stockfish scales and nothing else was found in the stomach at the time. Also no skeletal remains were found in the rest of the alimentary system.

Fish Remains—Unrecognizable.

On very frequent occasions remains of fish were found in stockfish stomachs, but digestion was so far advanced as to render identification impossible. At times otoliths were found and identifications were made, especially in the cases of stockfish and *Coelorhynchus fasciatus.*

In the smaller-sized stockfish the fish remains were generally of small fish, suggesting young *Myctophum* sp. and *Maurolicus pennanti*, but in the larger-sized stockfish such remains were probably mainly stockfish and *Coelorhynchus fasciatus.*

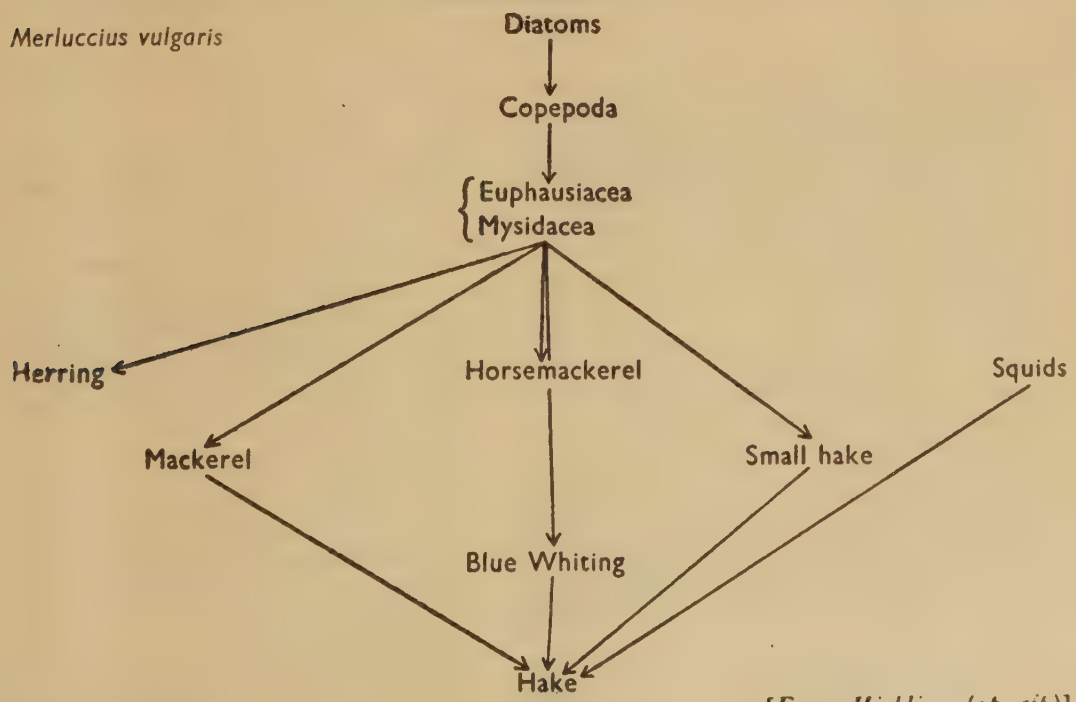
Stockfish—Empty.

By far the largest number of stockfish examined were found to be either empty or to have everted their stomachs. Out of 1,789 fish examined, 1,333 were found to have no organisms in their stomachs at all. From this it would seem that many more should be examined before a comprehensive idea of the diet of the stockfish is obtained.

The Food Cycle in Relation to Merluccius Capensis.

Hickling (1935) has worked out a food cycle in relation to the European Hake, *Merluccius vulgaris*, and it seems that it is very similar to that of our stockfish.

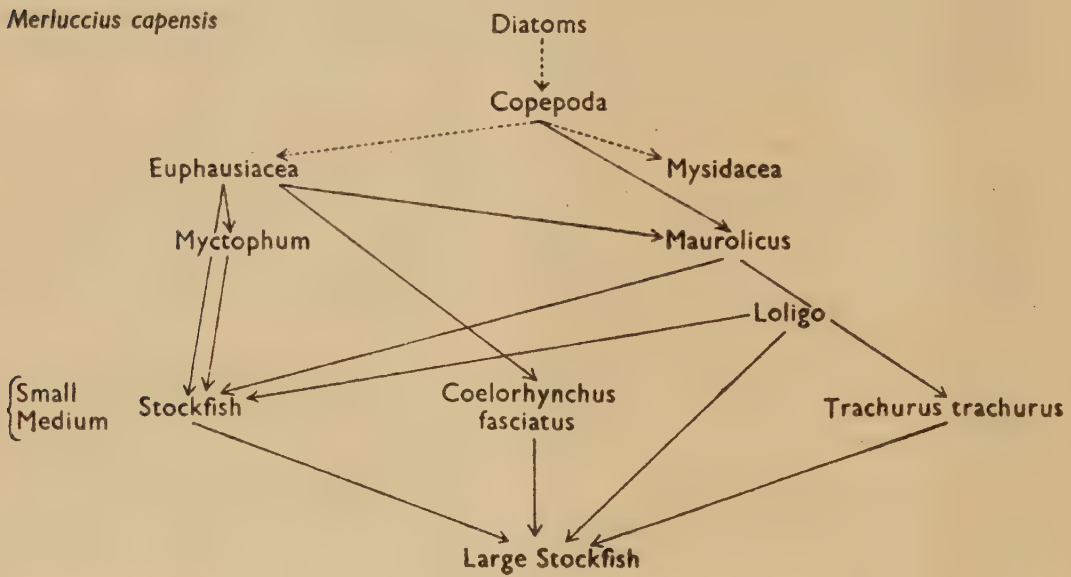
The food cycle diagram for the hake is as follows :—



[*From Hickling (op. cit.)*]

Diatoms are treated as being the basic food material eaten by Copepods, which in turn are eaten by Euphausiids and Mysids (krill). This krill is then eaten by small fish, such as herring and horse-mackerel and squids, together with mackerel and small hake and blue whiting. These fishes are all eaten by the larger hake. This gives a very simplified idea of the food cycle in *Merluccius vulgaris*.

The food cycle in the stockfish is probably on very similar lines to that of the European hake, and may be represented as follows :—



Again the basic food organisms are diatoms, which are eaten in general by Copepods, such as *Calanus* sp. No detailed examination of Copepod stomach contents has been carried out, but from occasional individuals examined it seems evident that diatoms form the bulk of their diet. The Copepods are eaten by Euphausiids such as *Thysanopoda* and *Euphausia*, and *Mysids*.

These are in turn eaten by small fish such as *Myctophum humboldti* and *Maurolicus pennanti*. The small and medium stockfish form the next and most important link in the food chain—these feed on *Myctophum*, *Maurolicus*, Euphausiids and Mysids. At the same size level in the chain, although not so important as food organisms, are the large-scaled rattails (*Coelorhynchus fasciatus*) and maasbankers (*Trachurus trachurus*). These three fishes then form the main food of the large stockfish.

As can be seen, this is only a very simplified form of the food cycle and many other organisms are involved, but the general trend and order of food organisms in relation to the stockfish is clearly shown.

Amongst the organisms listed by Rattray (op. cit.) as comprising the food of the stockfish were : *Scomber colias*, *Helicolenus maculatus*, *Tripterophycis gilchristi*, *Sebastosemus*, *Myctophum aeolochrus*, *Parapagurus dimorphus*, Echinoderms and Polychaetes. None of these was found in stomachs, but they may be classed as additional or "chance food" organisms. The subjoined list contains the following "chance food" organisms apparently not found by Rattray :—

Amphipoda—*Hyperia* sp.
Aegeon lacarzei.
Sergestes armatus.
Megalopa (crab larva).
Squilla armata.
Hyalaea tridentata.
Paralepis sp.

None of these is of any importance as a food organism to the stockfish, and the

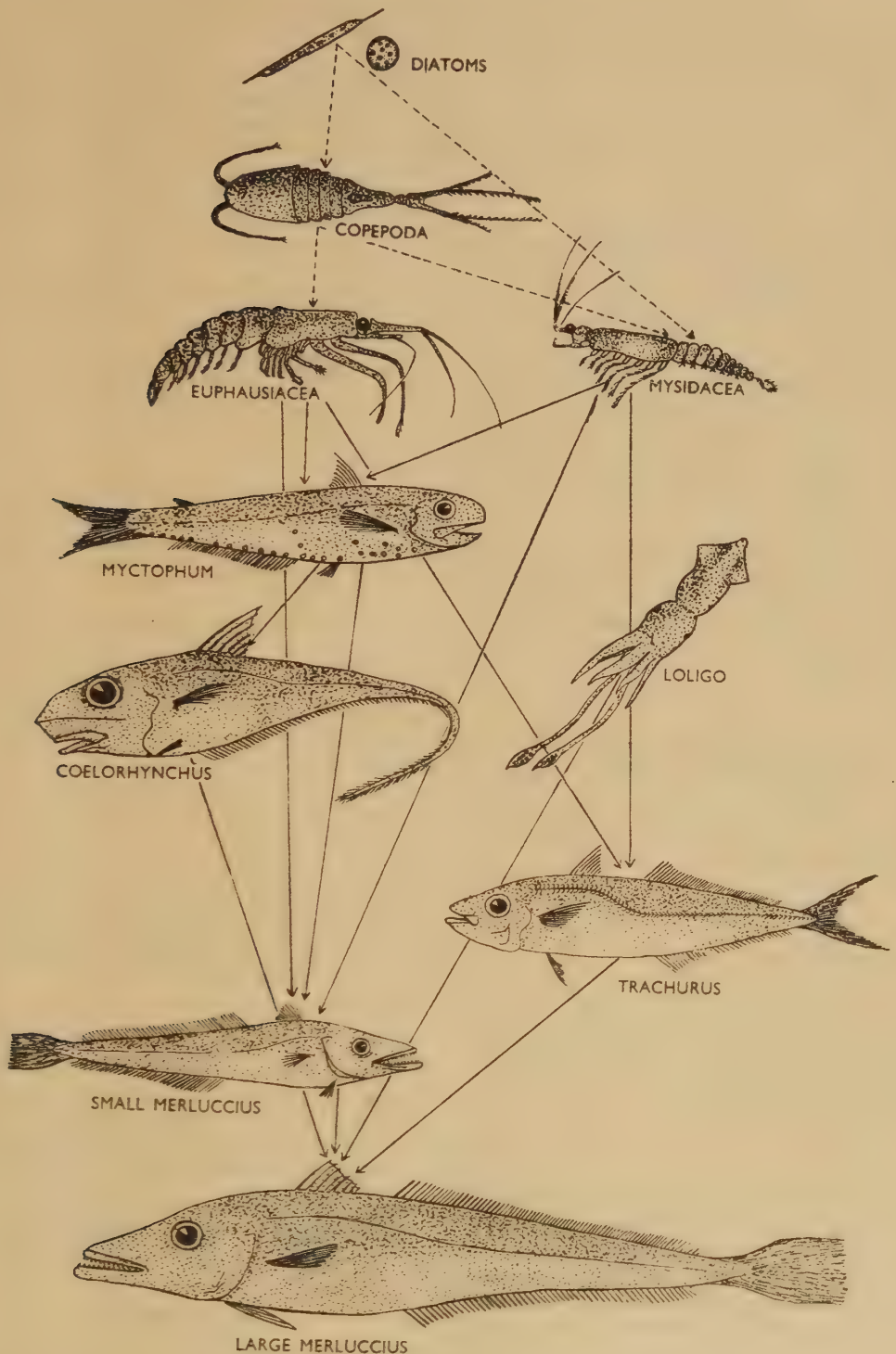

DIATOMS
COPEPODA
EUPHAUSIACEA
MYSIDACEA
MYCTOPHUM
LOLIGO
COELORHYNCHUS
TRACHURUS
SMALL MERLUCCIUS
LARGE MERLUCCIUS

PLATE IV.

organisms comprising the general food of the stockfish were found to agree with those found by Rattray both in identity and in relative importance.

The Food of Coelorhynchus Fasciatus (Günther.)

Coelorhynchus fasciatus, the large-scaled rattail, is a common fish on the West Ground and has a wide distribution, being found in sub-antarctic areas on the east and western sides of southern South America.

Although this fish is very good eating, and is caught in large numbers by the trawlers, it is little used commercially except as material for manufacturing fish meal. Probably its small size, unprepossessing appearance and difficulty in cleaning are reasons for its neglect as a food fish.

Small numbers of *Coelorhynchus fasciatus* were included in the weekly samples during the year, and lengths, weights, sex and gonad weights were taken and stomach contents examined. Altogether 114 of these rattails were examined.

The Food Organisms found in Coelorhynchus Fasciatus.

From Table 7 it is seen that altogether 16 different food organisms were recorded from *Coelorhynchus fasciatus*.

A.—Crustacea.

Euphausiacea.

Euphausiids of the following species, *Thysanopoda* sp. and *Euphausia* sp. were found in large-scaled rattails between lengths 200–450 mm. during the year. They appear to be a fairly important food organism in relation to the smaller fish.

Decapoda.

1. *Pagurus* sp. juveniles were recorded in stomachs in large numbers from January to July in rattails between lengths 250–500 mm. As many as 30 *Pagurus* were found in a single stomach. These appear to be of some importance as food organisms, at any rate, during part of the year.

2. *Prawns.*—A single specimen of *Funchalia woodwardi* was recorded in July. Prawns are probably chance food organisms which are eaten when available.

3. *Squilla armata* was found on three occasions, once in February and twice in July in rattails between lengths 350–500 mm. It may be an important article of diet.

4. *Mursia christimanus.*—Three specimens were recorded in August, but it is probably eaten more often than is apparent.

5. *Scyramathia hertwigi.*—Two spider crabs were recorded in August and are probably not important food organisms.

6. *Parapagurus dimorphus.*—Two specimens were recorded in April and may be fairly important food organisms.

Amphipoda.

A single specimen of *Hyperia* sp. was recorded in a small rattail in March. Amphipods may be of some importance in relation to the smaller rattails.

B.—Echinodermata.

1. *Ophiura* sp.—Specimens were recorded on five occasions during the months July, August and October in fish between lengths 200–400 mm. and are probably eaten fairly frequently.

2. *Crinoid.*—One specimen recorded in October.

C.—Mollusca.

Pteropoda.—A single specimen of *Hyalaea tridentata* was recorded in December. Others were obtained from different fish stomachs from the same sample.

D.—Polychaeta.

Chloeia gilchristi.—Seven specimens were recorded in five fish stomachs in the months February, June and August. These worms are probably fairly important as food organisms but appear to be seasonal in occurrence.

Rattray records *Eunice aphroditois* as being a food organism of *Coelorhynchus fasciatus* but none was found.

E.—Pisces.

Myctophidae.

Myctophum humboldti. A single specimen was recorded in June.

TABLE 7.—FOOD ORGANISMS IN *COELORHYNCHUS FASCIATUS*.

Length Categories in Millimetres.	Euphausiacea Thysanopoda sp.	Decapoda Pagurus sp.	Decapoda Funchalia woodwardi.	Decapoda Squilla armata.	Decapoda Mursia christmanus.	Decapoda Scyramathia hertwigi.	Decapoda Parapagurus dimorphus.	Isopoda Rocinela dumerilii.	Amphipoda Hyperia sp.	Echinodermata Ophiura sp.	Echinodermata Crinoid.	Pteropoda Hyalaea tridentata.	Polychaeta Chloeia glichristi.	Myctophidae Myctophum humboldti.	Callionymidae Paracallionymus costatus.	Stomiatidae Maurolicus pennanti.	Fish Remains Undentifiable.	Number of Fish Examined.	Number of Fish found Empty.
200–249.....	1†	—	—	—	—	—	—	—	—	1 (1)	—	—	—	—	—	—	—	2	1
250–299.....	2†	5 (23)	—	—	1 (1)	—	—	—	1 (1)	—	—	1 (1)	—	—	—	—	1 (1)	13	2
300–349.....	2‡	5 (29)	—	—	—	—	—	1 (1)	—	3 (3)	—	—	1 (2)	—	—	—	—	19	8
350–399.....	4†	7 (18)	1 (1)	1 (1)	—	—	1 (1)	1 (1)	—	1 (1)	—	—	1 (1)	—	2 (3)	2 (4)	—	37	16
400–449.....	1†	1 (6)	—	—	1 (2)	1 (1)	—	—	—	—	1 (1)	—	3 (4)	1 (2)	2 (2)	—	—	21	10
450–499.....	—	3 (23)	—	1 (1)	—	1 (1)	—	—	—	—	—	—	—	—	1 (1)	—	—	6	—
500–549.....	—	—	—	—	—	—	1 (1)	—	—	—	—	—	—	—	—	—	—	1	—
600–650.....	—	—	—	—	—	1 (1)	—	—	—	—	—	—	—	—	1 (1)	—	—	2	—
Totals																		101	37

Callionymidae.

Paracallionymus costatus.—Seven specimens were recorded in February and August in rattails between lengths 350–650 mm. These small bottom-living fish are probably an important food organism in relation to the general diet of the rattail.

Stomiatidae.

Maurolicus pennanti.—A single specimen was recorded in February.

General Remarks and Conclusions.

Although the recordings of pelagic organisms are almost as frequent as those of bottom-living organisms in the food of *Coelorhynchus fasciatus,* it seems probable that it is mainly a bottom feeder, as the structure and situation of its mouth on the ventral surface seems to be suited to the catching of organisms on the bottom. Probably the main food of *Coelorhynchus fasciatus* consists of bottom-living Crustacea, such as *Squilla* and *Mursia,* and small fish, such as *Paracallionymus.* Young *Coelorhynchus* probably feed mainly on Euphausiids and *Pagurus* juveniles when available.

Amongst the recordings of food organisms by Rattray (op. cit.) were :—

Exodromidia spinosa.
Pandalina brevirostris.
Calanus sp.

These three organisms were not found in this investigation, while the following may be regarded as new recordings of food organisms in *Coelorhynchus :*—

Pagurus sp. (juvenile),
Funchalia woodwardi,
Mursia christimanus,
Scyramathia hertwigi,
Parapagurus dimorphus,
Rocinela dumerilii,
Hyperia sp.
Ophiura sp.
Antedon sp.
Hyalaea tridentata,
Chloeia gilchristi.

Little further can be said on such a small number of recordings of food organisms.

The Food of Zeus Capensis (Cuvier and Valenciennes.)

Zeus capensis, the Cape John Dory, is very similar to, if not conspecific with, *Zeus faber,* the John Dory of European waters. It is caught by the trawlers of the West Ground throughout the year in fairly large numbers, and although it is very good eating, it is generally only used for fish meal.

Numbers of *Zeus capensis* were included in the weekly samples during the year, and lengths, weights, sex and gonad weights were taken and stomach contents examined. Altogether 358 John Dories were examined.

The Food Organisms found in Zeus Capensis.

From Table 8 it is seen that altogether 16 different food organisms were recorded from *Zeus capensis.*

A.—Crustacea.

Euphausiacea.

The following species were found :—
Euphausia similis,
Thysanopoda distinguenda,
Nyctiphanes australis.

Euphausiids were found throughout the year in John Dories between the lengths of 150–450 mm. but mainly between lengths of 300–400 mm. They constitute one of the most important of the food organisms in relation to all but the largest fish.

Mysidacea.

The following species were found : *Gnathophausia* sp. on one occasion in a juvenile male John Dory of length 123 mm. in April. Mysids are probably only eaten by young *Zeus capensis.*

Decapoda.

1. *Funchalia woodwardi.*—Two specimens occurred in John Dories of lengths 410–415 mm. in June. No other recordings of prawns were made in June, most being found in stockfish between January and April.

2. *Sergestes armatus.*—Two females were found amongst stomach contents in October.

B.—Cephalopoda.

1. *Octopus* sp.—Small *Octopus* sp., probably juveniles, were found during the months June, October and November in fish of lengths between 350–550 mm.

TABLE 8.—FOOD ORGANISMS IN *ZEUS CAPENSIS*.

Length Categories in Millimetres.	Euphausiacea Thysanopoda sp. Euphausia sp.	Mysidacea.	Decapoda Funchalia woodwardi.	Decapoda Sergestes armatus.	Cephalopoda Octopus sp.	Cephalopoda Loligo reynaudi.	Myctophidae Myctophum humboldti. Myctophum coccoi.	Stomiatidae Maurolicus pennanti	Stomiatidae Photichthys argenteus.	Stomiatidae Argyropelecus olfersi Argyropelecus hemigymnus.	Gadidae Merluccius capensis.	Coryphaenoididae Coelorhynchus fasciatus.	Carangidae Trachurus trachurus.	Fish Remains Unidentifiable.	Scales.	Number of Fish found Empty.	Number of Fish Examined.
100–149.....	—	1†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
150–199.....	1‡	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3
200–249.....	2†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	7
250–299.....	2†	—	—	—	—	—	1 (2)	1 (6)	—	—	—	—	—	1 (2)	—	1	6
300–349.....	22‡	—	—	—	—	—	14 (94)	3 (8)	—	—	1 (1)	—	—	4 (5)	1	29	73
350–399.....	22‡	—	—	—	4 (5)	2 (2)	28 (335)	12 (59)	2 (6)	2 (2)	1 (1)	—	1 (1)	13 (20)	—	53	140
400–449.....	20†	—	2 (2)	1 (20)	4 (4)	3 (3)	27 (315)	6 (60)	2 (8)	4 (8)	—	—	1 (1)	14 (27)	1	21	106
450–499.....	—	—	—	—	1 (6)	1 (1)	3 (30)	—	1 (7)	—	2 (3)	—	—	1 (5)	—	4	14
500–549.....	—	—	—	—	1 (2)	—	1 (3)	—	—	—	2 (2)	1 (1)	—	1 (1)	—	1	7
550–599.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
															Totals	117	358

2. *Loligo reynaudi* occurred amongst stomach contents in fish of lengths between 350–500 mm. during July, February and April. Cephalopods are probably of some importance in the general diet of *Zeus capensis.*

C.—Pisces.

Stomiatidae.

1. *Maurolicus pennanti* occurred in John Dories sized between 250–450 mm. in length, throughout the year.

2. *Photichthys argenteus.*—Twenty one specimens occurred in stomachs of fish of lengths between 350–450 mm. during the months October and November, but not otherwise.

3. *Argyropelecus hemigymnus.*—One specimen was obtained from a John Dory stomach in September.

4. *Argyropelecus olfersi.*—Nine specimens occurred in John Dories of lengths between 350–410 mm. in February. Stomiatids, especially *Maurolicus pennanti*, are most important food organisms of the John Dory.

Myctophidae.

Myctophum were found throughout the year and appear to be a very important food organism for John Dories between lengths 300–450 mm. but occur in fish of lengths of 250–550 mm.

Two species were found to occur, *Myctophum humboldti* and *Myctophum coccoi.* By far the most numerous were *Myctophum humboldti* (half-grown fish), *Myctophum coccoi* being found less frequently.

Gadidae.

On seven occasions, stockfish were found in John Dory stomachs in October, November and April. The length range of the John Dories was 300–350 mm. and the average size of the stockfish found was length 230 mm., weight 134 grammes.

Coryphaenoididae.

A single *Coelorhynchus fasciatus* juvenile was found in a John Dory of length 530 mm. in April.

Carangidae.

Two *Trachurus trachurus* were found in John Dories between lengths 365–410 mm. in April.

General Remarks and Conclusions.

It is seen that *Zeus capensis* feeds on pelagic and not bottom-living organisms, and that many of these organisms are those which are fed on by *Merluccius capensis*, for example, Euphausiids, Cephalopods, Stomiatids, Myctophidae, Coryphaenoididae, Gadidae, Carangidae and others. The John Dory is therefore a competitive feeder with the stockfish and is also a predator on young stockfish.

It seems that the smaller John Dories feed on Euphausiids and Mysids, the medium-sized, and by far the majority in this area, on Cephalopods, such as *Loligo reynaudi*, Myctophidae, Stomiatidae and Gadidae; and the large Dories on Carangidae and Gadidae.

Later examinations (May, 1947) of numbers of large *Zeus capensis* have shown them to feed to a great extent on *Trachurus trachurus.*

The Food of Helicolenus Maculatus (Cuvier and Valenciennes.)

Helicolenus maculatus, belonging to the family Scorpaenidae, is generally called the " Jacopever " by fishermen on the trawlers and at the docks. The name " Jacopever " is that given to *Sebastichthys capensis* which also occurs off the West Coast in shallower water, i.e., from 12–150 fathoms, whereas *Helicolenus maculatus* occurs in 50–300 fathoms. *Sebastichthys capensis* is generally caught closer inshore, while *Helicolenus maculatus* is caught in large numbers around the 200 fathom contour by the trawlers.

Helicolenus maculatus, sometimes known as the Sancord, is not used as a food fish, being small, spiny and difficult to clean, but is used mainly as material for fish meal. Altogether 378 Sancords were examined during the year.

The Food Organisms found in Helicolenus Maculatus.

From Table 9 it is seen that altogether 26 different organisms were found amongst the stomach contents of Sancords.

A.—Crustacea.

Euphausiacea.

The following species were found during the year :—

Euphausia similis,
Nyctiphanes australis.

TABLE 9.—FOOD ORGANISMS IN *HELICOLENUS MACULATUS*.

Length Categories in Millimetres.	Euphausiacea : Euphausia sp. Thysanopoda sp.	Stomatopoda Squilla armata.	Decapoda Pagurus sp.	Decapoda Pilumnoplax heterochin.	Decapoda : Solenocera sp. Pinnichalia woodwardi.	Decapoda Leontocaris paulsoni.	Decapoda Munida christmanus.	Decapoda Megalopa crab larvae.	Decapoda Parapagurus dimorphus.	Amphipoda Hyperia sp.	Mysidacea.	Cephalopoda Octopus sp.	Cephalopoda Loligo reynaudi.	Pteropoda Hyaleea tridentata.	Echinodermata Ophiura sp.	Echinodermata Ophiomyxa sp.	Echinodermata Crinoidea, Antedon sp.	Protochordata Salpa sp.	Protochordata Pyrosoma sp.	Polychaeta Chloeia gilchristi.	Coryphaenoididae Coelorhynchus fasciatus.	Myctophidae : Myctophum humboldti. Myctophum coccoi.	Stomiatidae Maurolicus pennanti.	Stomiatidae Argyropelecus hemigymnus.	Bothidae Arnoglossus sp.	Callionymidae Paracallionymus costatus.	Gadidae Merluccius capensis.	Gadidae Tripterophycis gilchristi.	Scorpenidae Helicolenus maculatus (Juv.).	Remains of Crustacea Unrecognizable.	Remains of Fish Unrecognizable.	Scales.	Number of Fish Examined.	Number of Fish found Empty.
200–219	3†	1 (1)	3 (13)	—	—	1 (1)	-	—	—	1 (1)	—	—	—	—	1 (3)	—	—	—	1 (1)	—	—	1 (1)	—	—	—	—	—	1 (1)	3 (3)	1 (4)	1 (1)	1	20	—
220–239	13‡	—	7 (58)	1 (1)	1 (1)	1 (1)	1 (1)	—	—	1 (2)	1†	—	—	—	5 (5)	—	—	—	—	2 (2)	1 (3)	—	2 (2)	1 (1)	—	—	—	2 (2)	5 (12)	1 (2)	3 (4)	7	59	2
240–259	19†	1 (1)	5 (33)	1 (1)	—	1 (1)	—	—	2 (2)	1 (2)	1†	—	—	—	9 (19)	—	—	—	3 (4)	2 (2)	10(27)	—	4 (5)	—	2 (2)	1 (1)	—	2 (2)	—	2 (2)	1 (4)	9 (13)	13	93	16
260–279	12†	3 (3)	3 (5)	—	1 (1)	—	2 (2)	1 (1)	2 (2)	1 (3)	—	—	1 (1)	—	13(45)	1 (1)	—	1 (1)	—	2 (3)	5 (13)	2 (2)	—	2 (2)	1 (1)	—	—	—	—	1 (2)	1 (2)	7 (12)	9	76	7
280–299	6†	2 (2)	1 (4)	1 (1)	1 (1)	1 (1)	1 (1)	3 (3)	—	1 (2)	—	—	2 (3)	1 (1)	1 (1)	14(42)	—	1 (2)	3 (3)	2 (2)	4 (24)	2 (3)	6 (12)	3 (3)	2 (2)	2 (2)	2 (2)	—	—	—	1 (1)	—	4 (4)	8	70	1
300–319	6‡	1 (1)	- -	—	—	—	1 (1)	—	—	—	—	1 (2)	1 (1)	—	5 (25)	—	—	1 (1)	—	—	—	2(3)	3(3)	1(2)	1(1)	—	—	—	—	2(3)	2 (2)	3	34	3
320–339	—	—	—	—	—	—	1 (1)	—	—	—	—	—	1 (1)	—	1 (1)	—	—	—	—	—	—	—	1 (1)	—	—	—	—	—	—	—	2 (3)	2	13	5
340–359	—	—	—	—	—	—	—	—	—	—	—	—	1 (1)	—	1 (2)	—	—	—	—	—	—	—	—	—	1 (1)	—	—	—	—	—	—	—	8	5
360–379	1†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1
380–399	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	3
Totals																																	378	43

Euphausiids were found to be most important in *Helicolenus* between lengths 220–280 mm. but were found in nearly all sizes during the year. Euphausiids constituted 14 per cent. of the diet of all the Sancords examined.

Mysidacea.

Unidentifiable Mysids were found only twice during the year in *Helicolenus* between lengths 220–260 mm. They are probably not very important as a food organism of the Sancord.

Decapoda.

1. *Squilla armata* was found on eight occasions during the year, but may be frequently eaten.

2. *Pagurus* sp.—Juveniles in large numbers were found in stomachs on nineteen occasions during the year in fish between lengths 200 mm. to 300 mm., making up approximately 5 per cent. of the diet of the fish examined.

3. *Prawns* were recorded in stomachs on three occasions, but were very much digested, so that no identification could be made. They were almost certainly either *Solenocera* sp. or *Funchalia woodwardi.*

4. *Leontocaris paulsoni.*—Four specimens of *Leontocaris paulsoni* were obtained during the year from fish between lengths 200–300 mm. in September, October and December.

5. *Mursia christimanus.*—Eight recordings of *Mursia christimanus* amongst stomach contents were obtained during the year, showing *Helicolenus* to be a bottom feeder.

6. *Pilumnoplax heterochin.*—Three specimens of *Pilumnoplax heterochin* were obtained during the year.

7. *Parapagurus dimorphus.*—Six specimens of the common hermit crab of the West Ground were obtained during the year.

8. *Megalopa* larvae.—A single Megalopa crab larva of unknown species was obtained in October.

Amphipoda.

Hyperia sp. was found on four occasions in fish between lengths 200–280 mm.; 8 specimens in all, in December and January.

B.—Mollusca.

Cephalopoda.

1. *Octopus* sp., probably juveniles, were found on three occasions in October.

2. *Loligo reynaudi* was found on five occasions in Sancords between lengths 260–360 mm. during the year.

Pteropoda.

Hyalaea tridentata.—A single specimen was found in December.

C.—Echinodermata.

1. *Ophiura* sp. was found on fifty occasions in fish between lengths 200–360 mm. throughout the year, a total of 142 specimens having been obtained. This Ophiuroid is very common on the West Ground and large numbers are found caught in the meshes of the trawl net as it is brought to the surface.

Although *Ophiura* sp. constitutes 13 per cent. of the general diet of the *Helicolenus* examined and therefore appears to be an important constituent, it is doubtful whether any great food value is to be found in the calciferous structure of the organism.

2. *Ophiomyxa* sp. was found on one occasion during the year.

3. *Antedon* sp.—A single specimen was recorded.

D.—Protochordata.

1. *Salpa* sp.—Five recordings of large Salps were made during August, September and October.

2. *Pyrosoma* sp.—Nine recordings of *Pyrosoma* sp. were made during the year in fish between lengths 200–300 mm. in December, January and April.

E.—Polychaeta.

Chloeia gilchristi was found on twenty occasions in *Helicolenus* of lengths between 220–300 mm. intermittently throughout the year, so forming an important food organism when available.

F.—Pisces.

Coryphaenoididae.

Coelorhynchus fasciatus.—Juveniles were found on seven occasions in Sancord stomachs from October to April and are probably eaten frequently.

Myctophidae.

Myctophum humboldti were found on ten occasions, *Myctophum coccoi* twice, and on four occasions the species was not found. *Myctophum* occurred in *Helicolenus* of lengths between 200–340 mm. throughout the year

and constituted 4 per cent. of the general diet of the fish examined.

Stomiatidae.

1. *Maurolicus pennanti* was found on eight occasions during the year.

2. *Argyropelecus hemigymnus.*—Five specimens were obtained during August and September from *Helicolenus* of lengths between 220–320 mm.

Callionymidae.

On three occasions *Paracallionymus costatus* was found to have been eaten.

Gadidae.

Two small *Merluccius capensis* were found in stomach contents during the year.

A single *Tripterophycis gilchristi* was obtained in December.

Bothidae.

A small possible *Arnoglossus capensis* was found in June.

Scorpaenidae.

Twenty juvenile *Helicolenus maculatus* of average length 28 mm. were found in twelve different larger fish of lengths between 200–300 mm. during December. No other recordings of *Helicolenus maculatus* as a food organism were made during the rest of the year.

General Remarks and Conclusions.

The very varied diet of *Helicolenus maculatus* suggests that it is an omnivorous feeder taking more or less anything which it finds, depending only on its size. Also it feeds on the bottom, as is obvious from the bottom fauna such as *Parapagurus dimorphus, Mursia christimanus* and *Squilla armata* found amongst the food organisms. It is a pelagic feeder as well, however, as is seen in the large numbers of small fish such as *Myctophum, Maurolicus pennanti*, etc., and Cephalopods which are found in the general diet.

There appears to be little change of food with increase in size in the fish examined, but small juveniles, apart from those found in stomach contents, were not obtained.

The presence of large numbers of juvenile *Helicolenus maculatus* in stomachs in December shows the Sancord to be another cannibal and probably indicates their spawning season to be during November.

The Food of Lionurus Nigromaculatus (McCulloch).

Lionurus nigromaculatus, the smooth rattail, is found in smaller numbers on the West Ground and is used as material for fish meal, although, like *Coelorhynchus fasciatus*, it is an excellent eating fish.

Since these fish occur in comparatively small numbers in the trawl nets, correspondingly small numbers have been examined. *Lionurus* has the same habit as the stockfish, in that it protrudes its stomach from its mouth, and in most cases the stomach contents are lost. Out of a total of 210 fish examined 111 were found to have empty stomachs.

The Food Organisms found in Lionurus Nigromaculatus.

From Table 10 it is seen that altogether 14 different food organisms were found.

A.—Crustacea.

Euphausiacea.

Euphausiids, *Euphausia* sp., were found on four occasions in fish of lengths 300–550 mm.

Decapoda.

1. *Squilla armata.*—Three specimens were found in May.

2. *Mursia christimanus* was found frequently throughout the year and is probably one of the most important food organisms of *Lionurus*, being a common bottom-living crab in this area. Eight per cent. of the diet of *Lionurus* examined was found to consist of *Mursia christimanus.*

3. *Parapagurus dimorphus*, although equally common, was found on only one occasion in stomach contents.

4. *Leontocaris paulsoni* was found on one occasion in November.

5. *Pagurus* sp.—Juveniles were found in large numbers on two occasions in February and March.

B.—Pisces.

Myctophidae.—A single *Myctophum humboldti* was recorded during the year.

Coryphaenoididae.

1. *Coelorhynchus fasciatus.*—Juveniles were recorded frequently throughout the year, and probably formed an important part of the general diet.

TABLE 10.—FOOD ORGANISMS IN *LIONURUS NIGROMACULATUS*.

Length Categories in Millimetres.	Euphausiacea Euphausia sp.	Decapoda Squilla armata.	Decapoda Leontocaris paulsoni.	Decapoda Mursia christmanus.	Decapoda Parapagurus dimorphus.	Decapoda Pagurus sp. (juv.).	Echinodermata Crinoidea, Antedon sp.	Polychaeta Chloeia glichristi.	Corryphaenoididae Coelorhynchus fasciatus.	Corryphaenoididae Lionurus nigromaculatus.	Gadidae Merluccius capensis.	Myctophidae Myctophum humboldti.	Stomiatidae Maurolicus pennanti.	Callionymidae Paracallionymus costatus.	Remains of Crustacea Unidentifiable.	Remains of Cephalopoda unidentifiable.	Remains of Fish Unidentifiable.	Scales.	Number of Fish found Empty.	Number of Fish Examined.
300–349.	2†	—	—	—	—	1 (2)	—	—	—	—	—	—	—	—	—	—	—	—	5	8
350–399.	—	—	—	—	—	1 (20)	—	—	1 (1)	—	—	—	—	1 (2)	—	—	3 (3)	—	—	6
400–449.	—	—	—	—	—	—	—	—	—	—	—	—	—	1 (3)	—	1 (1)	3 (3)	—	1	6
450–499	—	—	—	3 (4)	—	—	—	—	—	1 (3)	1 (1)	—	—	—	1 (1)	—	3 (3)	—	12	21
500–549.	2†	—	—	1 (1)	—	—	—	—	—	—	—	—	—	—	—	1 (2)	2 (2)	2	10	18
550–599.	—	—	—	2 (2)	—	—	—	—	2 (2)	—	3 (3)	—	—	—	—	1 (1)	7 (7)	—	27	42
600–649.	—	1 (3)	1 (1)	3 (3)	—	—	—	1 (1)	3 (3)	—	3 (3)	1 (1)	—	—	—	3 (3)	7 (7)	—	21	43
650–699.	—	—	—	4 (5)	1 (1)	—	—	—	1 (2)	1 (1)	4 (4)	—	—	—	—	2 (2)	3 (3)	—	23	39
700–749.	—	—	—	1 (8)	—	—	1 (1)	—	2 (2)	—	2 (2)	—	1 (1)	—	—	1 (8)	3 (3)	—	8	22
750–799.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1 (1)	—	2	3
800–849.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
850–899.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
																		Totals	111	210

2. *Lionurus nigromaculatus.*—Four juveniles were recorded on two occasions in October, showing another fish to have cannibalistic tendencies.

Stomiatidae.

Maurolicus pennanti was found on one occasion.

Callionymidae.

Paracallionymus costatus were found on two occasions.

Gadidae.

Small *Merluccius capensis* were found to constitute a fair amount, i.e., 6 per cent. of the general diet of *Lionurus* examined between lengths 450–750 mm. throughout the year.

C.—Polychaeta.

A single *Chloeia gilchristi* was found in November.

D.—Echinodermata.

A single Crinoid (*Antedon* sp.) was found in June.

E.—Cephalopoda.

Remains of Cephalopods, mainly beaks, were found on numerous occasions throughout the year, but no single specimen was complete enough for identification, although a comparison of beaks showed them to be very similar to those of *Loligo reynaudi.*

General Remarks and Conclusions.

Unrecognizable remains of fish were found frequently throughout the year, and from Table 10 it is estimated that 30 per cent. of the general diet of the *Lionurus nigromaculatus* examined consists of fish of which the species identified were *Coelorhynchus fasciatus, Myctophum humboldti, Merluccius capensis, Lionurus nigromaculatus, Maurolicus pennanti* and *Paracallionymus costatus,* while 16 per cent. is found to consist of Crustacea, amongst which were *Squilla armata,* Euphausiids, *Mursia christimanus, Parapagurus dimorphus, Leontocaris paulsoni* and *Pagurus* sp.

It is seen therefore that *Lionurus* feeds both on bottom-living and pelagic organisms.

The Food of Genypterus Capensis (Smith).

Genypterus capensis, the kingklip, occurs in relatively small numbers throughout the year on the West Ground and is one of the best food fishes of this area.

Since the length range of kingklip which occurred in samples during the year was from 360–1,340 mm., little change in diet in relation to size could be found.

The Food Organisms found in Genypterus Capensis.

From Table 11 it is seen that altogether 7 different food organisms were found.

A.—Pisces.

Callionymidae.

Paracallionymus costatus was found on eleven occasions, 30 specimens altogether, in kingklip stomachs in January, February, April, July and August, but probably forms an important article of diet throughout the year. Rattray found *Paracallionymus costatus* to be the most frequently found organism in stomach contents during his investigation of the kingklip.

Coryphaenoididae.

Coelorhynchus fasciatus occurred on three occasions in February and July, but is probably eaten during most months of the year.

Gadidae.

1. *Merluccius capensis* was found on three occasions, but is probably also an important food of the kingklip.

2. *Tripterophycis gilchristi* occurred twice during the year, and is probably not a very important food organism.

Scorpaenidae.

Six *Helicolenus maculatus* juveniles were found in a kingklip stomach in December, but are probably not regularly eaten.

B.—Crustacea.

Decapoda.

1. *Squilla armata* occurred three times, 6 specimens in all, in February and August, and may be regularly eaten.

2. *Megalopa* crab larvae were found in April.

General Remarks and Conclusions.

Rattray (op. cit.) recorded Cephalopoda, *Maurolicus* and Mysids as being food organisms, but none was found in the 67 kingklip examined. *Tripterophycis gilchristi,*

TABLE 11.—FOOD ORGANISMS IN *GENYPTERUS CAPENSIS*.

Length Categories in Millimetres.	Stomatopoda Squilla armata.	Decapoda Megalopa crab larvae.	Callionymidae Paracallionymus costatus.	Coryphaenoididae Coelorhynchus fasciatus.	Scorpaenidae Helicolenus maculatus (juv.).	Gadidae Merluccius capensis.	Gadidae Tripterophycis gilchristi.	Number of Fish found Empty.	Number of Fish Examined.
360–399.....	—	—	1 (1)	—	—	—	—	—	1
400–499.....	—	1 (1)	—	—	—	—	—	2	3
500–599.....	—	—	1 (5)	—	—	—	—	11	12
600–699.....	—	—	3 (4)	—	1 (6)	—	—	7	11
700–799.....	2 (11)	—	5 (19)	1 (1)	—	—	1 (1)	12	21
800–899.....	1 (5)	—	1 (1)	1 (1)	—	—	1 (1)	7	11
900–999.....	—	—	—	1 (1)	—	—	—	—	1
1,000–1,099.....	—	—	—	—	—	3 (3)	—	2	5
1,100–1,199.....	—	—	—	—	—	—	—	—	—
1,200–1,299.....	—	—	—	—	—	—	—	1	1
1,300–1,399.....	—	—	—	—	—	—	—	1	1
							Totals	43	67

Helicolenus maculatus and Megalopa crab larvae may be said to be new recordings.

In general, the kingklip appears to be a pelagic feeder, but the presence of *Squilla armata* and *Paracallionymus costatus* indicates that it feeds on the bottom as well.

Note on Brama Raii and Trachurus Trachurus.

1. *Brama raii* (Bloch).

Although very few *Brama raii* were included in samples from the trawlers, it is probably not as rare as it would seem, as there is always a rush made by the crew to get these fish from the last haul for "frys".

The length range of *Brama raii* which occurred in samples during the year was from 245–480 mm., and altogether 13 specimens were examined. Five of these were found to contain numerous, up to 15, *Myctophum humboldti*, while other food organisms were Megalopa crab larvae (23 on one occasion), *Loligo reynaudi* and a possible *Paralepis* sp.

This is a probable indication that *Brama raii* is not a bottom feeder, but feeds in mid and upper waters like *Merluccius capensis*.

2. *Trachurus trachurus* Linn.

Maasbankers of lengths between 230–450 mm. occurred in trawl samples from October to April, during which time 43 fish were examined.

Approximately 50 per cent. were found to have eaten Euphausiids and Mysids of the following species: *Thysanopoda* sp., *Euphausia* sp., and Mysids not established, while the remains of small red crustacea, possibly Amphipods of the genus *Hyperia*, were frequently found. Unfortunately, in every case the stomach contents were well advanced in the process of digestion and no sound identification could be made. *Myctophum humboldti* and *Maurolicus pennanti* were also found.

Both the male and the female gonads were found to be enlarged and functional during these months, and it appeared that spawning was in progress. According to Barnard, however, there is an inshore migration during October–January for the purpose of spawning.

Conclusion.

In conclusion it may be said that material has been obtained during the course of this research for:—

(1) a paper on the spawning of *Merluccius capensis, Zeus capensis, Helicolenus maculatus* and *Lionurus nigromaculatus* with notes on length frequencies, occurrence of sexes, etc.

(2) A paper on the Echinodermata of the West Ground with special reference to colour and unpreserved appearance of the starfish found.

(3) A short paper on a number of fishes of interest such as *Paralepis* sp., *Congermuraena albescens, Cyttus mccullochi* and *Centrolophus niger*.

These papers are in the course of preparation.

Summary.

1. In this investigation a list of the vertebrate and invertebrate fauna of the West Ground (a trawling ground off Cape Town), together with notes on the occurrence and relative abundance of organisms throughout the year are given.

This fauna list is made up of fish and invertebrates obtained in samples from the commercial trawlers using otter trawl nets, together with the organisms found as food in the stomachs of the fish examined.

2. The food organisms comprising the diet of six important species of fish of commercial value, found in South African (West Coast) waters are given.

Investigation was carried out over a period of twelve months and variation of food with age and size of fish together with seasonal variation are given.

The six species of fish were as follows:—

(i) *Merluccius capensis* (Castelnau), the Cape stockfish. Small and medium-sized stockfish were found to feed mainly on Euphausiids, Mysids and small fish of the family Myctophidae, while larger stockfish appeared to feed mainly on smaller stockfish, seasonally on *Trachurus trachurus* (maasbanker), and to a lesser extent on *Coelorhynchus fasciatus* (large-scaled rattail). The stockfish appears to be a pelagic feeder.

(ii) *Coelorhynchus fasciatus* (Günther), the large-scaled rattail. *Coelorhynchus* was found to feed on both bottom-living and pelagic organisms. Small rattails probably feed mainly on Euphausiids and juvenile Pagurids, while larger individuals appear to feed mainly on bottom-living Crustacea such as *Squilla* and *Mursia*, together with small fish, such as *Paracallionymus*.

(iii) *Zeus capensis* C. & V., the Cape John Dory. The John Dory was found to be a pelagic feeder with a diet very similar to that of the stockfish.

Small John Dories probably feed mainly on Euphausiids and Mysids, while larger individuals feed on squids, such as *Loligo*, small Myctophid fishes, small stockfish and *Trachurus trachurus*.

(iv) *Helicolenus maculatus* C. & V., the Sancord, or so-called Jacopever, was found to be a pelagic as well as a bottom feeder on a wide variety of different organisms.

(v) *Lionurus nigromaculatus*, the smooth rattail. *Lionurus* was found to feed on both bottom-living and pelagic organisms. Its diet consisted mainly of small fish and to a lesser extent of Crustacea such as *Mursia, Parapagurus*, etc.

(vi) *Genypterus capensis* (Smith), the kingklip. The main food of the kingklip appears to be the small bottom-living fish *Paracallionymus costatus*, but other small fish and Crustacea, such as *Squilla*, were found.

3. Short notes on *Brama raii* and *Trachurus trachurus* are given.

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EXPLANATION OF PLATES.

PLATE I.

Sketch-map of Area.

PLATE II.

Fig. 1.—The relative importance in relation to numbers of food organisms found in *Merluccius capensis* examined in length category 200–600 mm. throughout the year.

This figure has been constructed to represent the relative importance of the food organisms, based upon the number of recordings of the organism in the stomachs of the stockfish during the year. In practice 75 per cent. of the stockfish examined possessed everted or empty stomachs, so that this diagram represents the food of 25 per cent. of the fish examined.

In order of importance the organisms are as follows :—

(1) *Euphausiacea.*—Nearly half the food organisms recorded were of Euphausiids consisting of *Euphausia similis* and *Thysanopoda distinguenda.*

(2) *Myctophidae.*—Fishes of the genus Myctophum formed an important article of food. *Myctophum humboldti* was found most commonly, but *Myctophum coccoi* occurred as well.

(3) *Mysidacea.*—Mysids were found to be third in importance.

(4) *Cephalopoda.*—*Loligo reynaudi* occurred fairly frequently.

(5) *Stomiatidae.*—*Maurolicus pennanti* occurred fairly frequently.

(6) *Decapoda.*—*Solenocera* sp. and *Funchalia woodwardi* occurred periodically.

(7) *Gadidae.*—Young *Merluccius* were only eaten by the larger members of this group.

(8) *Coryphaenoididae.*—Young *Coelorhynchus fasciatus* were also only eaten by the larger members of this group.

(9) *Amphipoda.*—*Hyperia* sp. formed an unimportant article of diet.

Fig. 2.—The relative value of food organisms in *Merluccius capensis* in length category 200–600 mm. throughout the year.

This figure has been constructed to represent the relative value of the food organisms, using the average weight of the organism as an indicator of its food value. The values have been derived in each case from the product of the following :—

Number of recordings in stomach × number of organisms in stomach × average weight of food organisms in gms.

In order of importance the organisms are as follows :—

(1) *Myctophidae.—Myctophum humboldti* and *Myctophum coccoi.*
(2) *Gadidae.*—Young *Merluccius capensis.*
(3) *Cephalopoda.—Loligo reynaudi.*
(4) *Decapoda.—Solenocera* sp. and *Funchalia woodwardi.*
(5) *Stomiatidae.—Maurolicus pennanti.*
(6) *Euphausiacea.—Euphausia similis* and *Thysanopoda distinguenda.*
(7) *Coryphaenoididae.—Coelorhynchus fasciatus.*

In comparing figures 1 and 2 of plate II, it is seen that when the value of the food is represented by weight, Myctophidae become the most important food organisms and Gadidae and Cephalopoda next and Decapoda, Stomiatidae, Euphausiacea and Coryphaenoididae following.

It may be mentioned, however, that Euphausiids are eaten in very large numbers and their food value is therefore not truly represented in this diagram.

PLATE III.

The relative importance of food organisms in *Merluccius capensis* in length category 600–1,040 mm. throughout the year.

This figure has been constructed to represent the relative importance of the food organisms, based upon the number of recordings of the organism in the stomachs of the stockfish during the year. It represents the food of approximately 70 per cent. of the stockfish examined, the remainder being found empty.

In order of importance the organisms are as follows :—

(1) *Gadidae.*—Young *Merluccius capensis.*
(2) *Carangidae.—Trachurus trachurus.*
(3) *Coryphaenoididae.—Coelorhynchus fasciatus.*
(4) *Euphausiacea.—Thysanopoda distinguenda* and *Euphausia similis.*
(5) *Cephalopoda.—Loligo reynaudi.*
(6) *Myctophidae.—Myctophum humboldti* and *Myctophum coccoi.*
(7) *Stomiatidae.—Maurolicus pennanti.*

Fig. 2.—The relative value of food organisms in *Merluccius capensis* in length category 600–1,040 mm. throughout the year.

This figure has been constructed to represent the relative value of the food organisms, using the average weight of the organism as an indicator of its food value. The values have been derived as in the case of Plate II, fig. 2.

In order of importance the organisms are as follows :—

(1) *Gadidae.—Merluccius capensis.*
(2) *Carangidae.—Trachurus trachurus.*
(3) *Coryphaenoididae.—Coelorhynchus fasciatus.*

In comparing figs. 1 and 2 of Plate III, it is seen that when food organisms are represented by weight, small stockfish form nearly the whole bulk of the food, while *Trachurus trachurus* comprise a very secondary amount and *Coelorhynchus fasciatus* become almost negligible.

Trachurus probably become much more important during certain seasons of the year, but over a year's survey falls well into the background.

PLATE IV.

Food cycle of *Merluccius capensis.*